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The Moline Duplex Drilling Machine

By J. V. HUNTER
Western Editor, *American Machinist*

The machines herein described are designed to give rapid production on drilling work. All of them are of the two-head type, but they vary considerably in the method of operation, in order to suit the requirements of different classes of work. An examination of this article will show that the opposed-spindle method of drilling, which is becoming quite important, is well developed.

THE Moline Machinery Co., Moline, Ill., has developed a line of duplex drilling machines, in order to meet the demand for machines to drill holes simultaneously in opposite sides of work by means of opposed spindles. Machines of this type are necessarily somewhat special, as each is designed to meet the requirements of a particular job; but, at the same time, there is a certain amount of uniformity in their construction, as shown by the accompanying illustrations.

In addition to their use for opposed drilling, these machines are in some cases built to use one set of spindles for drilling and the opposite set for reaming. Or, drills and reamers can be held in the same head, and the work table shifted from the drilling position across the bed in order to align the work with the spindles for the reaming operation. An important feature of the design of such machines is the arrangement which permits the drilling and reaming spindles to be run at different speeds. The No. 7 duplex machine is shown in Fig. 1. The drive is from the three-step cone-pulley at the left through a central driving shaft, and from this through suitable gearing in the carriages or sliding heads. The gears can be changed so as to run the spindles on one carriage faster than those on the other, if desired. The spindles are driven from a long helical gear extending across the carriages, and the

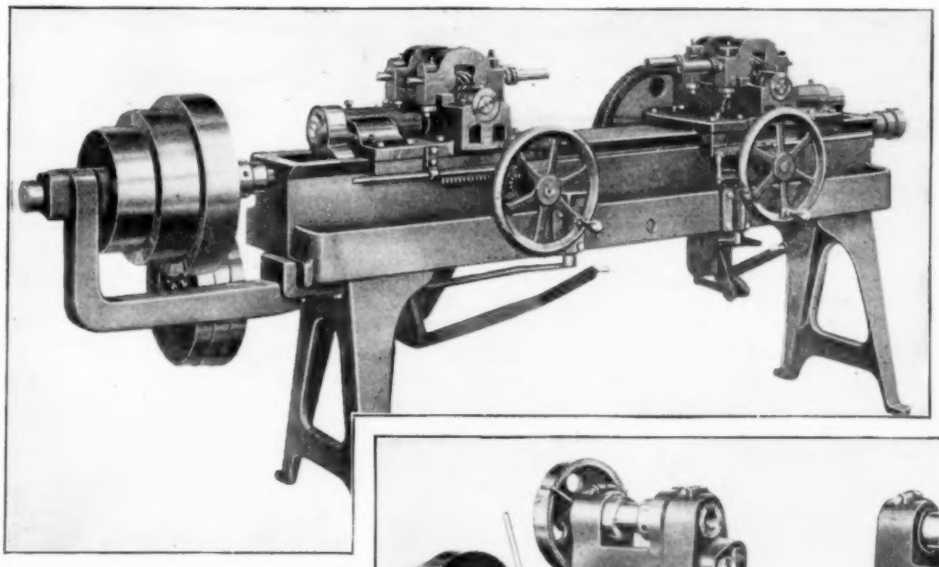


FIG. 1. NO. 7 POWER-FEED DUPLEX DRILLING MACHINE

Specifications: Length of bed, 7 ft. Width of bed, 10 in. Distance between spindle ends; minimum, 4 in.; maximum, 30 in. Hole in spindles, No. 4 Morse taper. Distance from spindle to bed, 8 in. Capacity, up to 1¼-in. drill. Each carriage has three feeds.

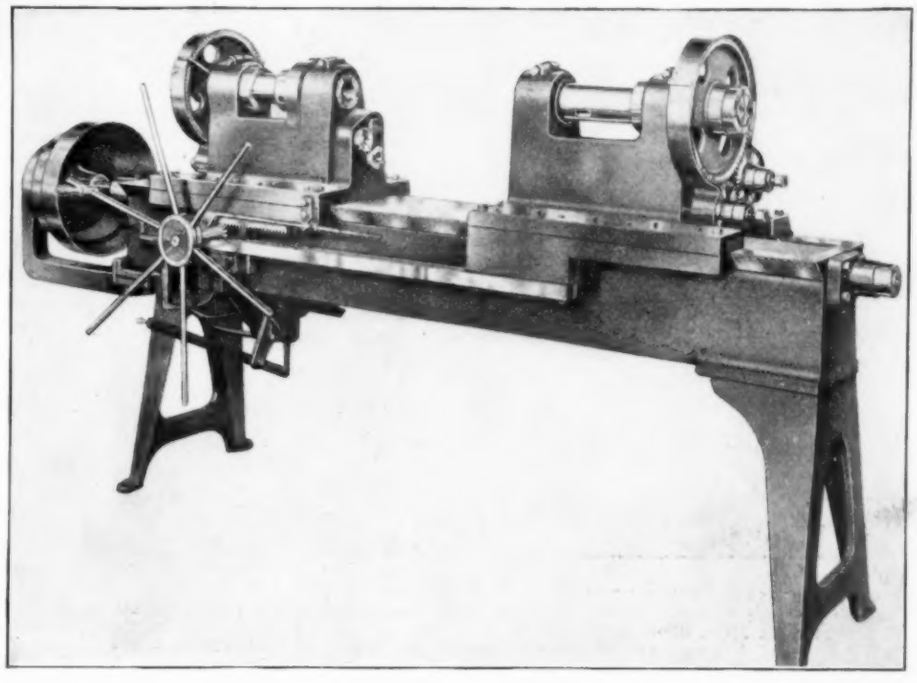


FIG. 2. NO. 8 HAND-FEED DUPLEX DRILLING MACHINE

Specifications: Length of bed, 7 ft. 8 in. Width of bed, 12 in. Distance between spindles; minimum, 10 in.; maximum, 40 in. Hole in spindles, No. 4 or 5 Morse taper. Distance from spindle to bed, 8 in. Capacity, up to 1⅜-in. drill.

FIG. 3. NO. 9 HAND-FEED DUPLEX DRILLING AND REAMING MACHINE

Specifications: Dimensions of table, 7 x 9 in. Height of table from floor, 32 in. Distance between spindle ends; minimum, 6 in.; maximum, 16 in. Travel of each head, 5 in. Hole in spindles, No. 3 Morse taper. Capacity, four ½-in. drills in cast iron. Floor space, 24 x 40 in. Net weight, 1,000 lb.

FIG. 4. NO. 10 DRILLING MACHINE WITH HEADS ARRANGED TO FEED IN SAME DIRECTION

Specifications: Dimensions of table, 7 x 12 in. Height of the table from floor, 32 in. Distance between spindle ends; minimum, 6 in.; maximum, 18 in. Travel of head, 6 in. Hole in spindles, No. 2 or 3 Morse taper. Capacity, four ½-in. drills in cast iron. Floor space, 24 x 40 in. Net weight, 1,200 lb.

heads holding the individual spindles are mounted so that they can be shifted closer together or further apart to suit the center distance required between the holes to be drilled. Each carriage is independently provided with three changes of power feed.

The bed of the machine is cast to form a coolant tank and its top is solid in the center of the machine, thus protecting the working mechanism from chips. The coolant flows down into chip troughs on both sides of the bed, and from this is drained off into the tank. A power-driven pump and the necessary piping for handling the coolant are furnished with the machine. The illustration shows the machine without a table for holding the work, as for most jobs a special jig and table are required.

The No. 8 duplex drilling machine, Fig. 2, has special spindle heads designed to meet the requirements given by a customer. This machine is similar in its general character and construction to the No. 7 duplex machine, with the exception that it is not equipped with power feed. The feed is actuated by the spoke wheel at the left through a pinion and two opposed racks, thus feeding the two spindle heads equally. An adjustable stop is located on the left-hand head, which permits regulation of travel in order to provide for drilling the holes to the proper depth and to prevent the two drills from coming in contact. The gears can be changed to drive one spindle faster than the other, if so desired.

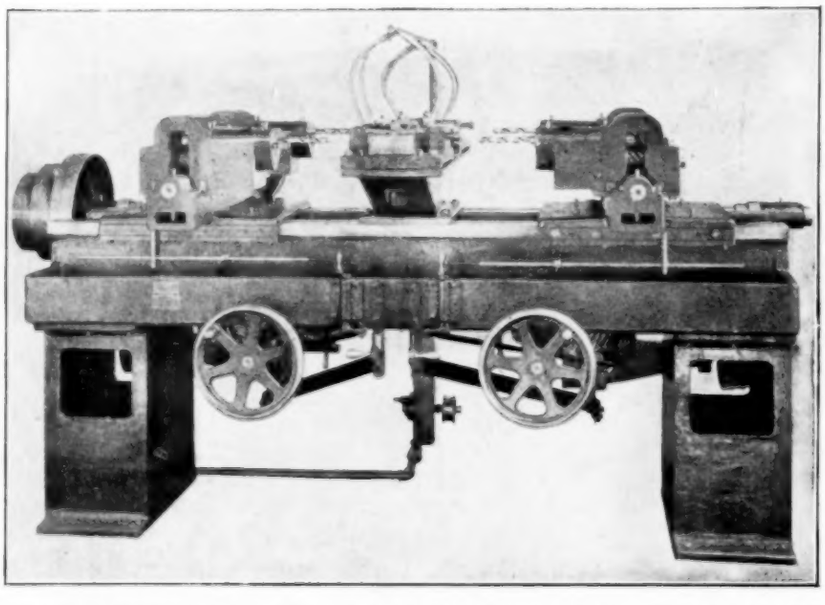


FIG. 5. NO. 12 DUPLEX DRILLING MACHINE WITH WORK TABLE AND JIG

Specifications: Distance between spindle ends; minimum, 8 in.; maximum, 44 in. Capacity, eight 1¼-in. drills in cast iron. Height of bed from floor, 40 in. Maximum center distance between end spindles on same carriage, 24 in. Floor space, 4 x 8 ft. Net weight, 5,000 lb.

Small Duplex Machines

The demand for a light, easily-operated drilling machine has been met by a size known as the No. 9, Fig. 3, which was originally designed for drilling and reaming the pin holes in the cylinder sleeves of a Knight type of gasolene engine. The two opposed spindles in front perform the drilling operation, and the two rear spindles the reaming. The machine is driven by two belts from the countershaft, one to each spindle head. It employs hand feed by rack and pinion, but power feed can be furnished if desired. The hand-feed machine is equipped with a ratchet lever and the power-feed machine with a handwheel.

The No. 10 duplex machine, Fig. 4, is similar to the No. 9 machine, except for the feed of the heads. The heads are geared to travel in the same direction, which arrangement is employed

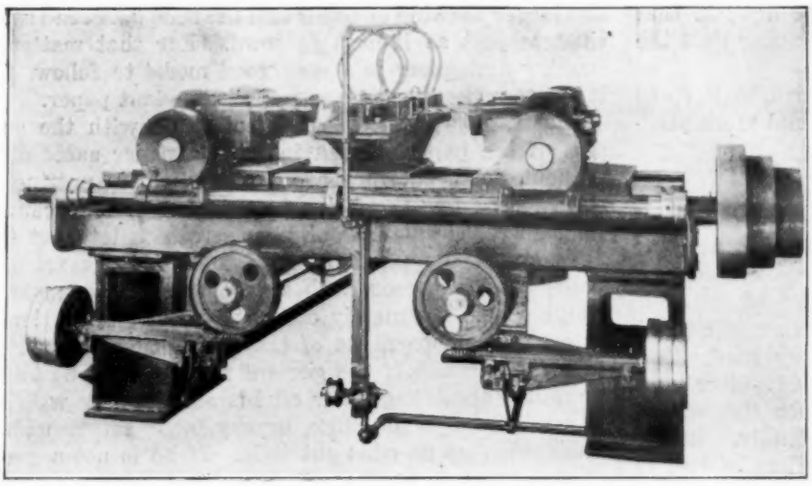


FIG. 6. REAR VIEW OF NO. 12 DUPLEX DRILLING MACHINE

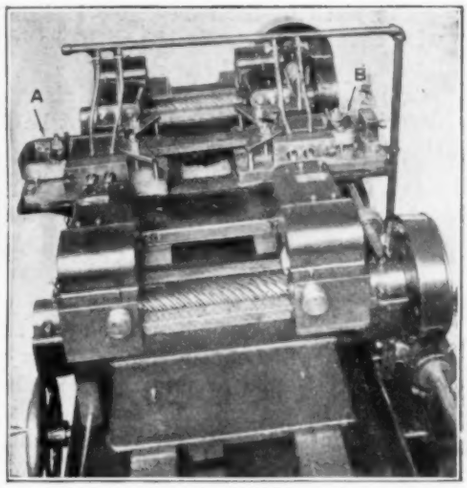


FIG. 7. TOP VIEW OF NO. 12 DRILLING MACHINE WITH WORK IN POSITION

when one head is used for drilling and the opposed head for reaming. Since special heads can be built to drill any number of holes at the same time, this feature is a desirable one, because it permits of drilling and reaming at a single setting of the work in the jig.

Duplex No. 12 Machine

The latest and most powerful of the Moline duplex drilling machines is the No. 12, which is shown complete with a work table and drilling jig in Fig. 5. The machine is provided with power feed, which can be automatically disengaged at any desired point. In addition, it has wheels for hand feeding on the front of the machine.

The power feed is driven through a worm and gear mounted on the back of the machine, Fig. 6, this being individual for each carriage and driven by a three-step cone pulley, which is, in turn, driven from the main drive-shaft of the machine.

The drive of the helical gears in the heads is effected from a shaft extending the full length of the machine along the back of the bed. This shaft is splined throughout its length for the sliding gears of the carriage, and is driven by a three-step cone pulley at one end. A power-driven coolant pump is provided, it being seen underneath the machine. It is driven from a small pulley mounted on the main drive-shaft, so that the coolant pump will be in operation only when the driving shaft is running. The coolant storage reservoir is located in one of the supporting bases, and the bed is cast with a trough along each side.

Two Heads on Each Carriage

The operation being performed with the setting shown in the illustration consists of drilling bolt holes through both ends of a built-up connecting rod for a steam pump. Fig. 7 is a view of the machine looking lengthwise along the bed, and the rod being drilled is located at *A-B*. The machine has two heads on each carriage, and each head has two spindles, making a total capacity of eight drills. Thus each of the four bolt holes is drilled from both sides at once. An adjustable stop is set on one side, so that the feed of one carriage is disengaged before the drills meet. This carriage then returns automatically to its starting position, while the other carriage continues to feed, so that its drills go past the center line of the connecting rod and join the two sets of holes. After the drilling operation is completed, one head is brought back far enough to remove the drills and insert reamers, and the four holes are reamed through from one side.

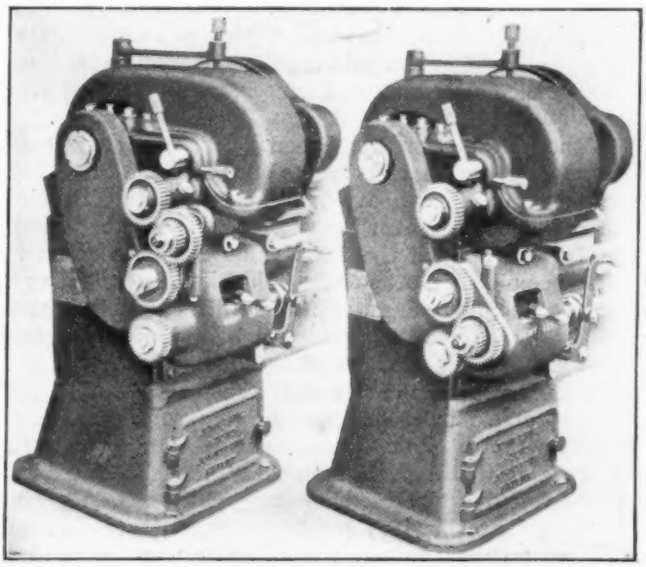
Cutting Screws of Quick Lead

By Charles Canec

Since reading the article by E. A. Dixie which appeared on page 883 of the *American Machinist*, in which he exp'ains a system of gearing up the lead screws with the cone direct instead of with the lathe spindle, when cutting coarse pitch screws on the engine lathe, the writer came across a catalog of lathes by John Lang & Sons, of Scotland.

The illustration, taken from this catalog, demonstrates a special feature which is applied to lathes having the back-gear quill in front instead of at the back. It will be seen that by swinging the idler gear to the top position, the lead screw is connected to a gear on the end of the back-gear quill, while in the lower position it is geared to the spindle direct, as is customary.

The back-gear quill is geared to the spindle by a reduction of 4 or 5 to 1, so that the strain on the change gears is correspondingly less.



A SCOTTISH LATHE WITH LEAD SCREW GEARED FROM BACK-GEAR QUILL

The pitch of the lead screw is ½ in., single, so that with equal gears connected with the back-gear quill the lead cut would be 2 in.

This scheme is a very good alternative to the one described by Mr. Dixie and might be found more practicable on some types of lathes.

The Plant Newspaper—How to Get It Read

BY ENTROPY

For upward of two years I acted as censor of a plant newspaper which was read. It was very rarely that a copy was found around the shop the day after publication. It was not only read by the men themselves, but was taken home and read by the family. In too many instances the men to whom it was handed had to take it home to find out what was in it, because they could not read English themselves.

I have been trying to make up my mind just why this paper was read. There were probably many reasons, but first of all this paper always stuck to what was plant news. This varies with the size of the shop, its location and the kind of newspapers in the town. In a village where there is no newspaper everything is plant news that occurs in and around the shop and in the homes of the workmen expect the little that is reported to the nearest city daily which is bought by these same workers. The editor of such a paper has the easiest time of any so far as strictly editorial work is concerned. In a small town, where there is a live newspaper published once a week which acts as correspondent to a city paper and gets considerable news published there, there is a minimum of plant news, for no one cares anything about a plant newspaper which has been "scooped" by several days, or by any time at all.

WHAT TO PRINT

In such a place the birth of a child is news for the plant paper because the local paper does not play it up, but at the most gives it three lines. The birth of triplets, however, while much more enticing to the editor is not good plant news because it has already been published by the local newspaper and reprinted by the city daily long before the plant paper can be written and printed. However, if the triplets are so much alike that their mother can only tell them apart because Susie has a mole on the back of her neck, then it is good plant news.

A boiler explosion is not good plant news for the same reason, but the fact that some one worked all day Sunday putting in new stay bolts and so obviated a shutdown, is good news for the shop paper. In other words, anything of which the news value has been taken by a paper published oftener than the plant paper ceases to be of value, but the more intimate details of that same item may be good news to print for the very reason that the people all know each other.

Here, however, the size of the shop comes into it. In a shop of a hundred men all in one room, there is no field for a plant paper because everyone knows all about everything that happens long before the editor does. In a shop of five hundred, however, while a certain kind of news travels swiftly by shop wireless, there is much of this intimate material that does not get around at all except as it is published. As the shop gets larger and larger the kind of paper and the time between issues changes just as it does in town. For that matter a country newspaper is a very good model to follow, for it has to make the same appeal as the plant paper.

Illustrations have a great deal to do with the success of the paper. I can imagine a paper succeeding without them, but they are a great help in putting it over. Very few shops are free from men who cannot read English, but only blind men can fail to get the message of the photograph of some of his friends. Every possible excuse should be taken for making photographs, not merely of workmen, but of workmen in action. Photographs of the management should be taken in action. If the general manager can be taken unawares shovelling snow off his sidewalk, or walking on snowshoes to the office, or any other rather undignified way, by all odds put it in. If he is not a good-enough sport to see the point and laugh with the editor and all the rest of the force, fire yourself before he fires you and get a good job. Don't have these illustrations so reduced in size that there is nothing left to see but the title. Sure, bills for cuts are made out at so much per square inch, but remember that you do not have to pay so much per thousand ems for setting type if you use them. There is some offset.

GOOD ENGLISH UNNOTICED BY MOST PEOPLE

As for English, good English is unnoticed by most people. That is, they read it without strain and without noticing that it is good. Stilted English is not good English. It is worse than an overdose of slang. There really is a limit to the amount of slang that should be interjected into a plant paper. Of course the language of the trade or of the sport which is being described should be used. A report of a baseball game in strictly correct English such as would be recognizable by use of an unabridged dictionary, would sound so stilted and snobbish that no one would read it. No one should object to the use of shop names for people as well as for things. No man has a right to object to being called "Bill" if that is the way he is called day by day in the shop and office. Unusual words should be avoided by all means. Keep the paper within the vocabulary of those whom you wish to read it. This makes it necessary to use a very limited range of words, but even the most common words can be made to tell the story that you wish to put over. It may not be easy to avoid repetition of the same words in a paragraph, but that is one of the minor faults. If nothing worse happens to the English language it is lucky. The plant paper affords the best possible chance for the management to communicate with its employees in an unofficial manner. The only danger is that some one high up in the organization may want to preach, and that is nearly the worst thing that language is used for, at least in the shop.

An editorial of two or three hundred words, expressing hope for the future of the business, telling men how they can rise in the organization or almost anything positive, is helpful and will be read. Editorials that are full of don'ts are harmful. The best little sermon I ever read was printed or lettered on one of the boards which usually say, "Keep off the grass." It was at East Aurora, and it said instead, "Why not use the path?" That is just what all these men want and need. Instructions as to what to do to get ahead. They get all the "don'ts" they need at home.

How Do You Regulate Materials?—III

By HENRY H. FARQUHAR

The principles upon which the replenishment, and the receipt and storage of materials should be based were outlined in two preceding articles. There remain only the considerations as regards the issuing of goods from the storeroom, the classification of materials, and certain principles to be kept in mind in arranging the inter-relationships between the various officials entrusted with maintaining material control.

(Part II appeared in our last issue.)

THE one outstanding requirement to be observed in releasing goods from the storeroom is that only necessary materials be supplied to authorized persons, and that they be properly accounted for when released. The rule therefore follows:

XVII. No Materials Shall Be Issued Except for Authorized Purposes, Upon Written Requests Signed by Specified Persons

This is simply equivalent to saying that we will permit only certain persons to draw against our bank account, and then only for authorized purposes and on designated blank "checks" or stores issues which may be used for accounting purposes. It does not mean, however, that we are to be parsimonious in furnishing supplies, or even that we may not adopt a liberal policy in supplying at cost such articles as the individual employees may desire. With the locked storeroom and a tight rein generally, accompanied by a judicious amount of what workmen are usually pleased to regard as "red tape," most of the needless requests will disappear of themselves, and a liberal policy in these respects may neutralize what might otherwise be considered an irksome system. Insistance must be placed, however, upon the written request, upon the approval by some responsible official, and upon seeing that the cost of each article issued is definitely "charged" to some specific account, be it personal or plant, and properly taken up in the records.

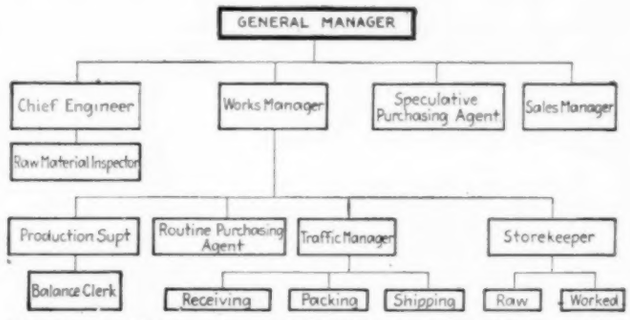


FIG. 7. TYPICAL ARRANGEMENT OF PERSONNEL CONNECTED WITH MATERIAL

It may be pointed out in passing, that through the routine of disbursing of materials a frequent check on the perpetual inventory may be secured. Thus, the balance as indicated by the bin tag may be entered on the issue slip, which, passing to the balance clerk for deduction, may be compared with the balance-sheet balance, or, when a bin tag becomes exhausted, this may be sent as a check, and so on. These are among the many ways in which the accuracy of the perpetual inventory may be maintained between the daily hand counts of a few items until, in the course of time, all items are covered.

XVIII. All Materials (Raw, Worked, and Factory Supplies) Should Be Carefully Classified and Preferably Mnemonically Symbolized.—This step is of course not indispensable, although if the methods be properly formulated it will contribute materially to the facility with which control may be gained and retained. The story of classification and symbolization is a very long one, and hence cannot be presented here. The bases for both the classification and the symbols should be carefully thought out, and the various components which may be conveniently incorporated—accounting charges, the product, stores, tools and machines, functions, etc., should all be tied together into a consistent and logical working system. If this be done, it will be found that a mnemonic system of symbols, based on careful classification, possesses many labor-saving and co-ordinating features in any business.

After all is said and done, we get back to the fact that rules, no matter how carefully formulated, and "system," no matter how carefully devised, cannot give us thorough control of the material situation unless we have real men entrusted with their execution working under rational relationships. I am not considering here the ever-present task of obtaining and training personnel; I am simply trying to indicate some of the more important means by which the work of that personnel may be made more effective on the job, and one of the most important features of effective control is efficient organization—the rational division of work and of responsibility between the various members of the personnel dealing with materials. The details of organization must naturally be determined after an analysis of local problems, conditions, personalities, and abilities.

It would be out of place, therefore, to attempt to formulate any specific rules as to who is to be whose boss, or as to exact distribution of functions. Again, in settling these questions, there are certain underlying considerations which must not be lost sight of, and the general rule may be stated:

XIX. Organization for Material Control Must Be Carefully Formulated

Remembering that we are dealing with values at least as important as money, and potentially (if neglected) of far greater importance, what we want is just as many independent checks and balances in responsibility and in clerical work as is consistent with speed and cost. The inter-relationships between persons has an important bearing on these questions not only in establishing necessary checks, but also in providing effective administrative control through a rational division of work.

It would seem offhand that, other things being equal, the responsibility for *quality* may logically be thrown

upon the engineering department or whoever exercises the engineering function. *Quantity* responsibility must be divided between the production department and the purchasing department, the former exercising authority in the case of routine purchasing, the latter in the case of speculative purchasing.

When I say responsibility must be "divided" I do not mean that there must be left any chance for dispute between these departments as to who is responsible for any individual article, but only that routine articles and speculative articles must be differentiated and responsibility for them definitely assigned. The *time* element must be similarly divided again between production and purchasing—the one specifying when to renew for all items as per balance sheets (production requirements), the other to be responsible for the time necessary to secure the article and for seeing that it be secured in this time. *Cost*, finally, is distinctly the purchasing agent's affair. In practically all cases which I have encountered where losses were frequent through unsystematic material procedure, the underlying cause was traceable directly to an illogical or to an ambiguous delegation of these four functions. Too often, indeed, they were all thrown upon the shoulders of one man, the purchasing agent.

Following out this suggested distribution of responsibilities, it would seem logical that in the normal case, administrative relationships may usually be blocked out according approximately to the following plan, which has proved satisfactory in numerous cases. The purchasing agent for speculative purchasing may be under the general manager; for routine purchasing under the works manager or the production superintendent. In small plants where both routine and speculative purchasing must be conducted by one man, he should, of course, usually report to the general manager. The storekeeper ordinarily should be under the works manager; or, less preferably for purposes of checks but more for speed, both the balance clerk and the storekeeper may be under a head material man who in turn is under the works manager or the production superintendent. This is the arrangement frequently found in larger plants. The inspector may be under the engineering department. The receiving clerk may be under the traffic department, which may report either to production or to sales. These relations, however, will vary with cases; they are suggestive only as an arrangement which is workable and working, and which probably furnishes maximum checks with minimum labor and routine. A skeleton administrative chart of a satisfactory arrangement of the personnel dealing most directly with materials, under typical conditions might therefore look somewhat like Fig. 7.

The list of requirements of adequate material control as outlined in this series may look somewhat fearsome to many. The satisfactory thing about the material problem, however, is the fact that it is one of those nearly inanimate phases of the work which can be systematically regulated if we will only take the trouble to go after it. This is not true of many other features of factory work, particularly those which re-act more strongly on the human element and which therefore keep forever and continuously bobbing up. This fact adds emphasis to the desirability of eliminating as far as possible the material troubles from among those confronting the manager, so that he may give undivided attention to the recurrent problems. For after all, in spite of the many factors which must be taken into account, an adequate material system is essentially a simple affair, conferring benefits entirely out of proportion to its cost.

Socialism—Communism

(Reprinted from *American Machinist*, June, 1878, when H. B. Miller and Jackson Bailey were editors.)

The whole country is just now somewhat excited upon the question of Socialism or Communism, especially since the demonstrations recently made in St. Louis and other localities by organized bands of agitators rallying under the red flag. The danger to be apprehended from this element in our body politic has doubtless been greatly exaggerated by the daily press, yet it is not altogether groundless. The inquiry is naturally raised, who are Communists and what do they aim to accomplish? The leaders will probably answer that they are workingmen who demand their rights, but as far as we can learn there are no real workingmen leading the movement, unless the keepers of gin mills and lager-beer saloons, like "citizen" Justice Schwab, of police-court notoriety, may be called workingmen.

Socialism is nothing new in this country, but judging from its aims and results, the type we are now called upon to deal with is radically different from that which we have long had in full development. For many years Communistic societies have flourished in the United States, the most prominent of which are the Shakers, the Oneida Community and the Economites, of West Pennsylvania. The members of each of these societies own considerable property in common, but, unlike the plan of the new communists, they have acquired it by industry and thrift, and have never looked to the Government for aid to compel the possessors of wealth to part with a portion of it for their benefit.

The Communism that is now striving to incite a reign of terror, is not an element of home growth, but has been transplanted from abroad. It is an offshoot from the Communism of France that rioted in blood and plunder for a brief period in Paris in 1870; from the Nihilism of Russia, so lately threatening the safety of that government, and from the Socialism of Germany, that, a short time since, came near causing the Emperor's death. Judging from their results, we can much better get along with the domestic article than with the foreign.

The new Communists parade with arms, and threaten to bring on a revolution if their demands are not complied with. They hold public meetings, and make speeches to convert others to their schemes of aggression. The old established Communists are opposed to force of arms and never start public agitations to gain legislation for their benefit. They urge no one to follow their system of life. The new declare for free rum and lager; the old have fundamental rules which exclude all intoxicating drinks. The former by the very existence of their organizations menace all peaceful government; the latter are included among the most orderly and law abiding citizens of our country.

In short, the former strives to pull down, while the latter labors to build up. The ideas and practices of the settled American Socialists do not agree with those universally accepted by the great body of our intelligent citizens, but they do not conflict with the general welfare, and form no disturbing element in our free republic. The new Communists, or rather "freebooters," should be taught a few wholesome lessons in the strength and stability of peaceful institutions.

Tight Fitting Threads For Bolts and Nuts*

By CHESTER B. LORD

"Without sacrifice of strength, without increase of rejection, without additional manufacturing costs, find a method whereby a male and female thread of the same lead and pitch diameter may be made, after repeated loosenings, to fit right without the aid of a locking device."

WHAT is the cause of our periodic dissatisfaction with threads when in general they are so satisfactory? What other machine element is so easily made or is so satisfactory as regards strength? Why are there so many different kinds of threads when all are equally satisfactory, or rather unsatisfactory? Furthermore, is the dissatisfaction founded on performance or merely upon theory? Also, is the form or angle of thread a matter of importance, or merely an excuse for mathematical gymnastics? The only answer the writer has been able to elicit in reply to these various questions is that we are looking for a better thread; which statement, however, is rather indefinite and usually simply means a thread that will pass the gage. Of course, the real object of the search has been to find a thread that will not loosen.

In the past we have attributed our troubles to the fact that our fits were not close enough—the engineer's alibi for a poor design. But fundamentals cannot be violated in mechanics any more than elsewhere in nature, and we are attempting to violate two by insisting upon our present methods of inspection: (*a*) that interchangeable manufacture is a matter of percentage which depends upon tolerance and cost; and (*b*) that a force fit is not possible between two parts the surfaces of which are complements one of the other.

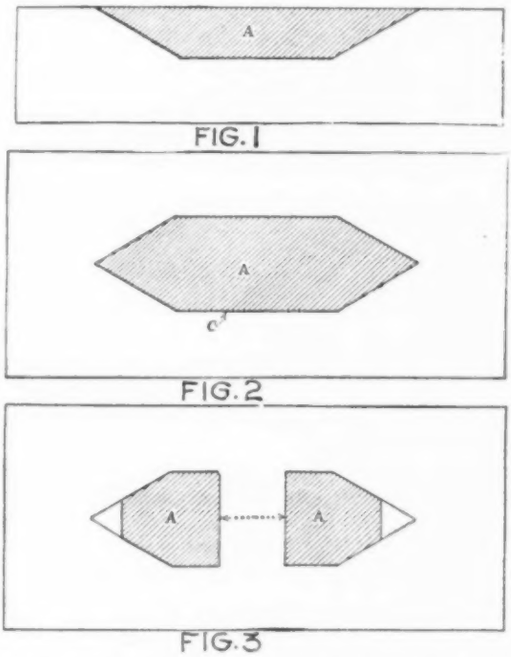
Having in mind the first fundamental, it is obvious that the chances of securing a perfect fit are limited by the cost, and the second fundamental would seem to render this entirely hopeless. It is therefore proper to conclude that a good fit is usually due to error, and that if changing both male and female threads produces no relative change, changing one thread must of necessity do so. It is the object of this paper to demonstrate that by making this latter change threads can be produced that are interchangeable practically regardless of tolerance, that will not loosen, and are cheaper to manufacture.

A physician always diagnoses a case before prescribing, so let us do likewise. The loosening of a thread fit is caused by vibration or repeated shock, the chief result of which is to flatten and burnish the parts of the thread that are in contact. This produces a slight looseness and the nut tends to follow the thread incline until it again fits. The same performance is repeated until finally the nut reaches an obstacle too large to flatten, or else the bolt and nut vibrate in unison and there is no further relative movement. This same phenomenon occurs in the case of a bolt screwed in a tapped hole.

Experiments with spring lock washers having a projection that will not allow the nut to turn without cutting the metal, and the same type of washer made without holding projections, show very little difference in their holding power; and this would seem to indicate that their function is to prevent vibration. But we also find nuts without lock washers in places where there is vibration, and still they do not loosen. The answer is that they are individually fitted.

The writer can remember in his shop days picking out and numbering nuts and bolts, and every mechanic knows that he cannot take the bolts out of a cylinder head on an engine of good make and put them back again indiscriminately. They must go back into the holes from whence they came. All have demonstrated to their satisfaction the fact that a tight thread will not loosen by vibration, and that one with tolerance will, unless it is prevented from loosening by a lock washer or its action limited by some type of nut lock. We cannot lessen our tolerance because the tap wears small and the die wears large, and the lesser cannot contain the greater.

To gain a better conception of the problem to be solved, consider a board cut as shown in Fig. 1. We cannot obtain a forced fit between the two pieces because one surface is the complement of the other. If we apply a force to *A*, we are no better off because the pieces cease to fit the instant the pressure is released. We may therefore state as a rule that where two surfaces are complementary to one another a tight fit cannot result without some means of maintaining pressure. But if we cut the board as shown in Fig. 2, theoretically removing no material, we can replace *A* without force, and any pressure exerted will not make a tight fit unless we distort *A* or drive a wedge at *C*. This is analogous to a perfect thread, and driving the wedge at *C* is



FIGS. 1 TO 3. APPLICATION OF PRESSURE IN THREAD FITS

Fig. 1. Two complementary surfaces. Fig. 2. Surfaces analogous to two perfect threads. Fig. 3. Surfaces on which there can be maintained a forced fit.

*Presented at the Spring meeting of the American Society of Mechanical Engineers, St. Louis, Mo., May, 1920.

equivalent to introducing a slight difference in lead. If, now, we cut off the ends of *A* as shown in Fig. 3, and apply a force in the direction shown, we can obtain a forced fit because only the angles are complements and because we have a method of maintaining pressure. We can also even distort *A* because we have room for it to expand. We have only then to provide for three things: a method of making the parts in contact absolutely complementary; the introduction of sufficient metal; and a method of maintaining pressure. With our present type of thread we can only meet one of these—namely, that of partly maintaining pressure. This is demonstrated in Fig. 4, which shows in an exaggerated manner the effect of off lead.

To secure a good fit it is necessary to exert pressure on all flanks of the thread, and not on only two as we do with a standard thread. Practice demonstrates that the nut and bolt must be held by internal pressure on all flanks, and that the force maintained by screwing the face of the nut against another surface does not prevent loosening; but the writer again affirms that for practical purposes an off-hand thread is better than a perfect one, because in our present practice it is the lead or burrs that usually determine the fit.

While two slightly varying leads make a better fit, both as regards gaging and in actual use, this practice is not to be commended. Using a different lead to secure a fit is doing imperfectly on one side of the thread what the different-angle method does perfectly on both sides, because by having the leads identical and the thread supported on both sides, we secure a uniform finish instead of a distortion. Where the leads are different, the amount of distortion necessary to secure a fit increases with each thread. Thus, if the lead of a 20-thread stud is 0.05 in. and we make it 0.052 in., it will be 0.002 in. off center on the second thread and 0.018 in. on the tenth thread. This is entirely possible, and superior to a so-called perfect thread as regards fit, but a distortion, unmechanical, and unnecessary.

This is what is done with railroad fish-plate bolts where the specifications state the minimum foot-pounds at which the nut and bolt may be assembled. The impossibility of meeting these requirements in quantity production is recognized by purchasing agents and most engineers, and so the lead is slightly changed. This, however, is merely a subterfuge and really defeats the purpose of the specifications in that it permits of a poorer and weaker thread than would otherwise be possible.

We are thus confronted with this problem: Without sacrifice of strength, without increase of rejection, without additional manufacturing costs, find a method whereby a male and female thread of the same lead and pitch diameter may be made after repeated loosenings to fit tight without the aid of a locking device. This, according to specifications, calls for a full thread at contact points, pressure applied continuously on all flanks, and maximum strength at the pitch line. This means the addition of surplus metal to the male (which is the only one affected) sufficient to fill out the female threads, which would be an impossibility were it not for the ductility and elasticity of steel. If we add this surplus metal we will find that we can more than fulfill the required conditions by changing the angle of the male thread to a lesser one than that of the female, having the two intersect on the pitch line.

Theoretically, this means a smaller amount of material below the pitch line of the male, compensated for

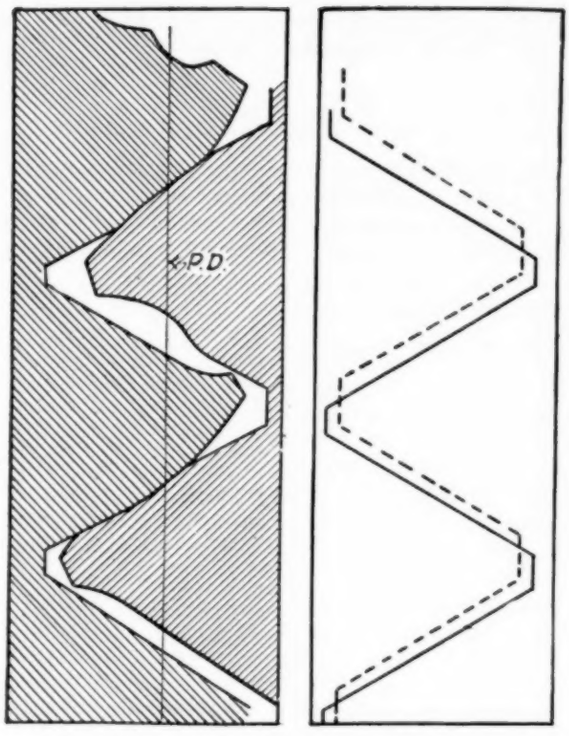


FIG. 4. THE EFFECT OF LEAD (GREATLY EXAGGERATED)

by an increased amount above the pitch line. Actually it means *more*, because we do not have to recognize as great a tolerance below the pitch line because of our lesser angle, nor above the pitch line because we can take care of a reasonable surplus and the question of initial fit need not be considered. The space below the pitch line in the male, due to difference of angle, is not as great as the tolerance usually allowed.

Every nut is bell-mouthed, and every bolt, whether cut or rolled, is tapered. This is fundamental and cannot be avoided. This being so, we have no trouble in entering, for one or two threads, a bolt of larger angular but less total displacement than the female, It is also true in practice that the first threads of either nut or bolt are weaker than the rest, because they lack support on one side and hence flow easily.

When a male thread of this type and a standard mate are screwed together, we will have transformed a male of lesser angle to one of larger angle or of wider base than the standard U. S. thread, because we have filled out the female thread tolerance as well as that of the male. We will also have uniform pressure on all flanks; the maximum possible material at the pitch line; a hard, smooth surface analogous to a case-hardened one; a fit that will remain snug despite repeated removals and that may be screwed together by ordinary means; and yet will still retain an interchangeable bolt and nut according to U. S. standards. The nut has not been changed or distorted in any way, but has simply served as a finishing roll.

The writer has stated in a previous article that, aside from threads, nowhere else in machine work do we expect micrometer limits on a roughing cut; and the question naturally arises whether an operation similar to that described would not be an effective finishing and sizing operation for commercial work. This would be the equivalent of *making* them fit the gage, and would greatly reduce the cost due to rejections. It would still have variable nuts and the necessity of sizing them.

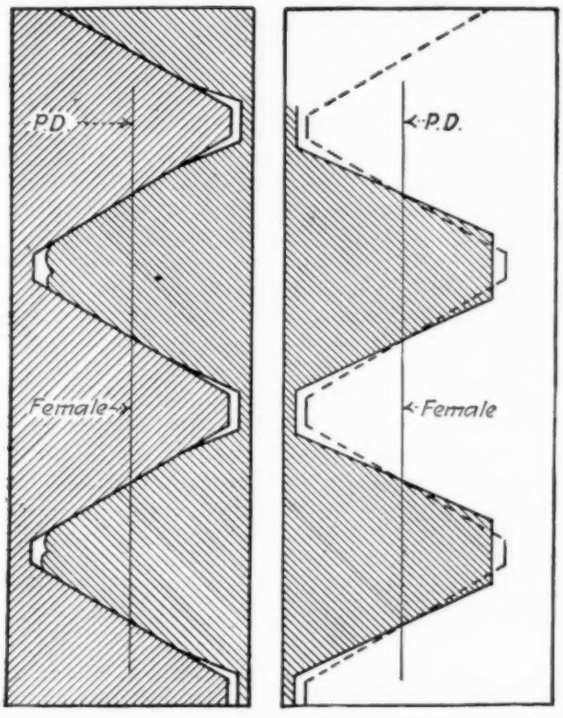


FIG. 5. DIFFERENT ANGLE THREADS (GREATLY EXAGGERATED)

Let us now see what authority and precedent we have for making so radical a departure from accepted practice. To do so, let us consider how threads are made, especially by rolling. Generally speaking, thread rolling is circular knurling, knurling being that process whereby the diameter of a part is increased at certain points by a corresponding reduction of diameter at other points, due to pressure alone. It is applicable to both flat and round surfaces, but for the purpose of this article we will consider only round surfaces.

In turning screws and bolts to size the diameter is held, generally speaking, to the pitch diameter. The displacement of metal from the root and lower flank forms the addendum under the process. Cutting a thread on a bolt with a die is a somewhat analogous operation, the similarity increasing as the die becomes duller. For a die-cut 1-in. bolt it will generally be found that with a diameter of 0.990 in. a fuller thread may be secured than with one of 1.000 in., the explanation being that with the die we secure a combined cutting and rolling operation. Due to lack of clearance, if the diameter is too large, part of the metal is pressed into the bottom of the die and with such force that it drags and is torn off, thus leaving a thread of smaller outside diameter. This same phenomenon occurs when a nut is too tight.

If we require a holding fit on a shaft, do we use tolerances that allow of the shaft being several thousandths smaller than the hole it is to fit? Quite the contrary. We not only specify the fit but also the minimum pressure allowable to assemble the two parts, and we do this both for single units and for quantity production. We might term a shaft and rotor spider a nut and bolt with microscopic threads and assembled with a right-angled instead of a helical motion. Why not fit our bolts the same way, making our tolerances plus instead of minus and using a force fit we can depend upon when it means no change in the tools necessary for assembly?

If we look at a finished commercial thread through a microscope, it will be seen that the edge is serrated and that slivers stand up all over its surface. By running a nut over it once we but slightly change its appearance, but by repeatedly doing so—always using a tight nut—we may finally burnish the thread so that it will not thereafter change its size and will have a surface somewhat comparable to a case-hardened one.

The writer has stated that the different-angle thread was practically independent of tolerance. This is self-evident on the finishing operation. Let us now see how true it is as regards the roughing operation. Excluding the ideal condition, there are six variables that may be met with, and these are caused by large and small angle on both male and female. A diagrammatic sketch will show that of six possible variations due to angle alone, the different-angle thread is usable on four, and the U. S. thread on only two. Any multiplication of these errors of angle by maximum or minimum tolerance would obviously still further favor the different-angle thread.

Fig. 5 shows diagrammatically the different-angle thread with the angles of the male greatly exaggerated to demonstrate the principle. We are complying in this case with all the conditions we have just been discussing: we are making the lesser contain the greater, angularly speaking; we are applying force from both directions, at right angles to the axis of the bolt; we have made the angles complementary—not merely two equal angles; we are securing the maximum strength at and near the pitch line, and transforming a thread with a lesser angle than that of the standard male to one with a larger angle, thus filling out the space perfectly and so doing away largely with vibration; and we are securing, whether under pressure or not, contact on all flanks, whereas the standard thread when under pressure secures contact on possibly one-half the flanks, both because it is compressible and because it does not fill the female thread. The only problem to be solved, therefore, was to find an angle of such slope that it could be formed without distortion of the nut or requiring too much force to screw home. To demonstrate this, threads as small as No. 10-32 were used, and as being of possible interest, the writer presents a brief outline of the engineers' report of the experimental work.

Results of Experimental Work

Diagrams of the different threads were first laid out on a 100 to 1 scale so as to determine approximately the most suitable angles to be tested, the Löwenherz thread with an angle of 53 deg. 8 min. being used as a basis. The nut was to have the regular Löwenherz thread with same diameter and pitch as in the 155-mm. shell adapter used by the U. S. Government.

Threads of 44 deg. and 45 deg. for the plugs seemed most favorable, and accordingly the following cold-rolled steel plugs were made up, with nuts having the same pitch diameter and lead as the plugs, but a thread angle of 53 deg. 8 min.:

1 Angle of thread 44 deg. 54 min., pitch diam. 0.8748, lead 0.0787
2 Angle of thread 45 deg. 2 min., pitch diam. 0.8748, lead 0.0787
3 Angle of thread 44 deg. 0 min., pitch diam. 0.8748, lead 0.0787

Test No. 1. Nut No. 1 and plug with thread angle of 44 deg. 54 min. were screwed together *without* a lubricant. They were started about a half a thread by hand, and then an 8-in. wrench was used for about four threads. The plug was then in so tight that a 10-in. wrench was required to turn it to full depth. After a

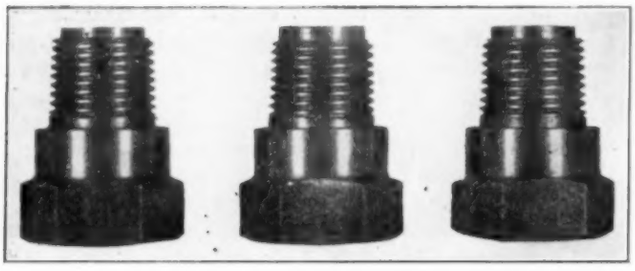


FIG. 6. THREAD USED ON SPARK PLUGS

couple of backward turns the plug stuck so tight that a 20-in. wrench would not move it. The nut was then sawed open and removed from the plug and about one-third of a thread of the plug was taken off in a piece of the nut. A magnifying glass showed that the threads in both plug and nut were drawn and cut out of shape where there was a tendency for them to overlap, due apparently to too much metal and no lubricant.

Test No. 2. Nut No. 2 and plug with thread angle of 45 deg. 2 min. were screwed together *with* a lubricant. They were started by hand for about one-half turn, then an 8-in. wrench was used for five or six threads, and a 10-in. wrench for the remainder. The plug came out slightly easier than going in. After this had been repeated three times the plug could be screwed in by hand. The maximum and minimum plug gage for the nut showed no change in the thread of the nut. Under a magnifying glass it was seen that the metal had flowed to the top of the plug thread from about the pitch diameter outward. The plugs were screwed into the nuts fifty times and there was still what could be termed a "snug fit."

Test No. 7. Plugs were tried out with commercial 1-in. nuts. The thread angle of the plugs was 58 deg., and the pitch diameter 0.9228 in., with one plug this diameter plus 0.001 in., and one minus 0.001 in. This diameter allowed the plug thread in the layout to overlap the entire thread of the nut instead of only half, as in the previous cases. The nuts used were picked out of stock for size with a standard 1-in. thread gage. The smallest plug went into the nut easily by hand. The largest two went together easily with an 8-in. wrench. After being twice screwed together with the wrench, they went together with a snug fit by hand. The magnifying glass showed that the thread from near the pitch diameter outward had been drawn and compressed slightly.

Tests with S. A. E. Threads

Test No. 9. Plugs of ½-in. diameter with pitch diameters of 0.4684 in. and 0.4699 in. (same as ½-in. S. A. E. nuts) and a thread angle of 50 deg. were tried with commercial ½-in. S. A. E. nuts. The difference in the two pitch diameters made practically no difference in the fits, as they both readily went in with an 8-in. wrench. After they had been screwed together four times, they would go together by hand, but without shake. After they had been screwed together 75 times there was still what could be termed a "snug fit."

Test No. 10. An attempt was made to compare the strength of an S. A. E. standard ½-in. thread with a 50-deg. thread of the same size. The plug with the standard thread on one end and the special thread on the other end was used with standard nuts. A pull of 14,000 lb. was gradually applied and the metal began to give way, which prevented an additional load. During this pull observations were made to determine if there was any "give" in either of the threads, but both remained the same throughout. The nuts were removed and there was no apparent distortion of the threads.

Test No. 12. In this test ¼-20 plugs with pitch diameters of 0.2165 in. and 0.2181 in. with 50-deg. angle were tried out with ¼-in. U. S. standard nuts, one being a commercial nut and the other of a standard size but made in our toolroom—the tap being 0.250 in. in diameter. Both nuts were tried with a ¼-in. standard plug gage, both being apparently the same size. The nut made in the toolroom was screwed on the maximum plug and went on about one and a half times its length and then stuck and would not go either way. It was finally removed by hammering it on the sides. The threads were rolled and torn from about the pitch diameter outward, but there was not that tendency for the metal to roll upon the outside of the thread as in the previous tests, the outside diameter being only 0.251 in. as against its original 0.250 in.

The commercial nut went on the minimum plug with an extremely tight fit, but it came off very readily with the wrench and left quite a different thread from the previous one. The thread was not torn at all but rolled out to almost a perfect V-thread with outside diameters of 0.2555 in. as against the original 0.250 in. The outside diameter of the tap for the commercial nut must have been over 0.250 in. to allow this metal to flow out to 0.2555 in. and not jam the nut. If the toolroom tap had been sharper on the flats or its outside diameter greater, there would have been room for the metal in the test plug to flow out to a larger diameter and avoid tearing the thread, and consequent jamming of the nut. Two facts are clearly demonstrated: first, necessity of room for metal to flow; second, one of the limitations of the thread gage.

Test No. 13. Plugs corresponding to standard 10-32 with 50-deg. angle were tried out with standard 10-32 nuts; pitch diameters 0.170 in. and 0.1716 in. They were a trifle too tight a fit to go together by hand, but after being screwed together once with a wrench they went together by hand snugly.

Conclusions

In conclusion it may be stated that the tests would seem to indicate the following:

a The cause of stripped threads is lack of room into which the metal can flow

b The pitch diameter should be the same in both threads

c The lead should be the same

d The thread angles should differ by not more than 10 deg.

e The limits for the inside diameter of nut need not be adhered to closely, as the inner part of the nut thread exerts very little, if any, holding power.

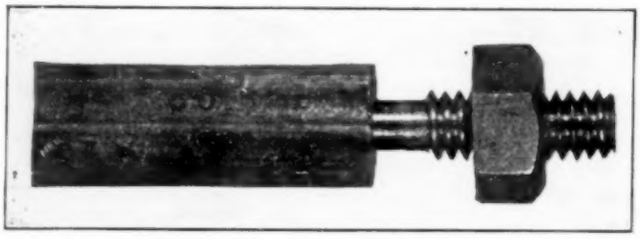


FIG. 7. DIFFERENCE IN THREAD BEFORE AND AFTER NUT HAS BEEN SCREWED ON

f The outside diameter of plug and pitch diameter of both plug and nut are important and should be adhered to fairly closely.

As might be supposed the subject of threads has brought forth considerable discussion but practically all of it favorable.

One writer suggests that the statement regarding stripped threads might cause confusion, as they are usually caused by too much room rather than by too little; incidentally this is another bad feature that the different angle thread will eliminate, for no nut can be screwed on by hand, and so there must always be sufficient material to prevent stripping because of too much tolerance, or too little material.

Another writer suggests the use of a 55-deg. Whitworth bolt and a 60-deg. Sellers nut. The only objection to this is that the Whitworth thread being rounded would not flow as readily as would the Sellers, and would not carry as much material; but it would undoubtedly make a better combination than we are using at present.

Fig. 6 shows the thread used on spark plugs to give a gas tight fit, and Fig. 7 a stud with a nut screwed partly on to show the difference in the thread before and after a nut has been on. Note the difference in the thread above and below the nut.

A Short Proof for Long Division

By Walter R. Meyers

Chief Tool Designer, R. K. LeBlond Machine Tool Co., Cincinnati, Ohio

Modern practice demands efficiency in all branches of work, and any method or idea tending to increase the production of any employee, in any capacity, increases the efficiency of the business. With this idea in mind, the writer wishes to submit the following method of proving long division, in the hope that it may give the designer, draftsman or tool engineer a short cut in his mathematics.

When I wish to positively prove a calculation, I desire to see it in plain figures, thereby eliminating mistakes on slide rules or in the use of logarithms. The advantage of this method, that of simplicity, is self-evident, as it relies on nothing but plain addition for positive proof. Being so simple, I dare say that it is not new; but to the best of my knowledge it is not generally used.

The method will be shown by the use of the following numerical example. Dividing 1.25 by 0.98362, the quotient is 1.2708, with a remainder of 15704, as can be seen by the work given later. The proof of this would be 0.98362 times 1.2708, plus the difference 0.000015704, which gives 1.25, the original dividend. But this number has already been obtained in our division, so that the terms and final remainder can be totaled, disregarding the dividend and the remainders which are shown in italics in the following example:

```
0.98362) 1.250000000 (1.2708
         98326
         ------
          266380
          196724
          ------
         *696560
          688534
          ------
            802600
            786896
            ------
             15704
Proof: 1.250000000
```

Further explanation is unnecessary, but I may add that should there be a mistake in subtraction or multiplication it would show up in the addition and it would be in the column in which the first deviation of the sum from the dividend occurred, when reading from the right. For illustration, suppose that the remainder *696560* marked* in the example was, due to a mistake in substraction, made to read *695560*. The result would be:

```
.98362) 1.250000000 (1.2707
        98362
        ------
         266380
         196724
         ------
        *695560
         688534
         ------
           702600
           688534
           ------
            14066
Proof: 1.249900000
          *
```

The appearance of the 9 in the total indicates a mistake in the column marked by the star, and the error in subtraction can be quite easily located. The writer hopes that others may find this method as useful as he has found it.

Piston Clearance in Cylinders, and Why

By Frank C. Hudson

I have modified my opinion about automobile repair ever since talking with someone who really seems to know that a gasoline motor is more than a few holes in a chunk of cast iron with some sort of dingus wabbling around inside. I ran across one the other day in a shop where they had two Heald cylinder grinding machines, a Norton crankshaft grinding machine, other tools to match, and were running them day and night.

The head of the shop first saw the light of day in the Emerald Isle, had worked in some of the best motor shops in Great Britain, and was now the happy possessor of the afore-mentioned outfit. He had a system of fitting pistons to cylinders, which was claimed to be very successful, varying the clearance from 0.0015 to 0.003 in., according to the kind of motor.

Slow Motor Needs Liberal Clearance

According to his theory a slow-running motor does not scavenge the burnt gases well and these get down into the crankcase, dilute or otherwise injure the lubricating oil, and the pistons seize unless there is a liberal clearance. He bears this out by citing instances where a motor which will seize when run in high gear, will run perfectly if run in second or low to get higher engine speed.

Motors with scanty cooling systems, such as small radiators or restricted passages, also require more clearance, yet he gives the Franklin pistons no more clearance than most water-cooled engines because of the piston speed and oiling system used.

Piston rings were also discussed and he told of a case where a Sunbeam motor with three ⅛-in. piston rings was refitted with pistons having but two rings ¼ in. wide. With only this change the car showed over 15 per cent greater speed on the Brooklands track.

It would be interesting to know how these theories and experiences compare with those of others who really think about such matters.

The Keller Automatic Die-Sinking Machine

By S. A. HAND
Associate Editor, *American Machinist*

While the term die is both comprehensive and elastic and may be applied to a great variety of tools, it is to be understood that the machine described in this article is for sinking dies such as are used for forging, glass molding, embossing, etc., and which contain the sunken negative of the piece to be formed or decorated.

THE die requirements in this country have been greatly multiplied within the last few years and it is clear that they must continue to increase. With the ever growing scarcity of die sinkers and the increasing demand for their product it would seem that the only solution of the problem would be in the employment of a mechanical method to do the work.

Some years ago automatic machines for sinking dies were brought out by the Keller Mechanical Engraving Co., Brooklyn, N. Y., and while for many years their use was confined to ornamented die work, the vast die requirements incidental to the war were partly responsible for the development of types suited for larger and heavier work.

Fig. 1 illustrates the machine in which the master and the work are both shown in position. The master *A* and the die to be sunk, *B*, are both mounted on the upright platen *C* while the tracer *D* and the cutter *E* are carried by the latticed frame *G* on which the motor is also mounted.

For convenience in counterbalancing, the platen is arranged to travel up and down in a vertical plane, provision being made for easily regulating the amount of motion. The member carrying the cutter has a longitudinal travel, either to the right or to the left at a right angle to that of the platen. This member, in addition to its longitudinal travel, is arranged to swing on a pivot at *H* so that by weights attached near its outer edge by a chain the tracer is held against the master and the cutter against the work. The depth of the cut is regulated by the relative end positions of the tracer and the cutter in relation to the master and the work.

Both the weights for counterbalancing the work and platen and those for holding the cutter to its work can be changed in accordance with the requirements.

The cutters used are quite simple to make and are of two types—round-nosed and diamond-shaped.

Fig. 2 is a close-up view of the master and a partly completed die, the sizes of which are shown by the scale to be seen lying on top of the die. The greatest depth of this die is 2½ in.

As is plainly indicated in the illustration, the direction of the cut is vertical and the feed longitudinal while the depth is provided for by the swinging motion of the pivoted latticed-member carrying the tracer and cutter, the amplitude of the swing being entirely governed by the depth of the impression in the master.

Dies having a number of duplicate impressions on the same block may be cut from a single master by shifting the master to the right or left, up or down, a predetermined distance after each impression is finished. For work of this class a simple fixture is provided to insure accurate registering.

For producing such work as molds for bottles, it has been found convenient to equip the machine with

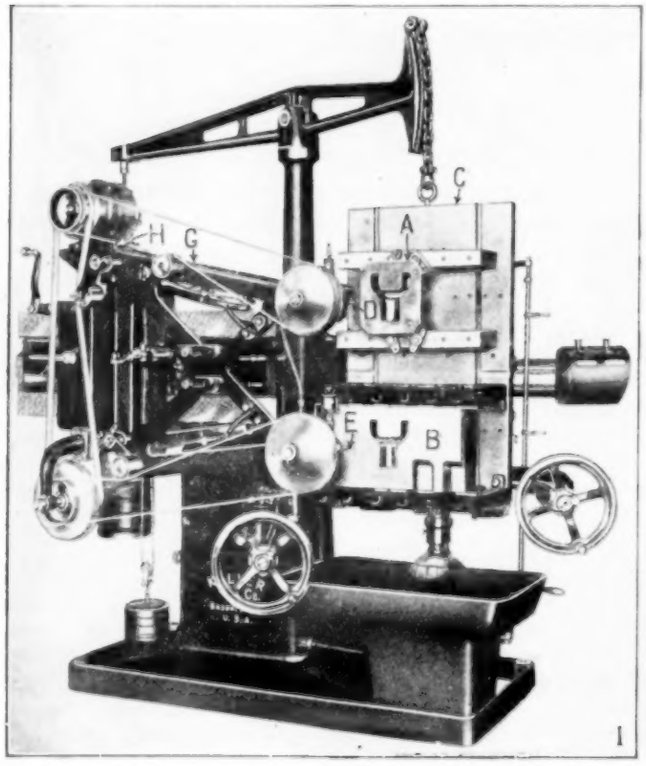


FIG. 1. KELLER AUTOMATIC DIE-SINKING MACHINE

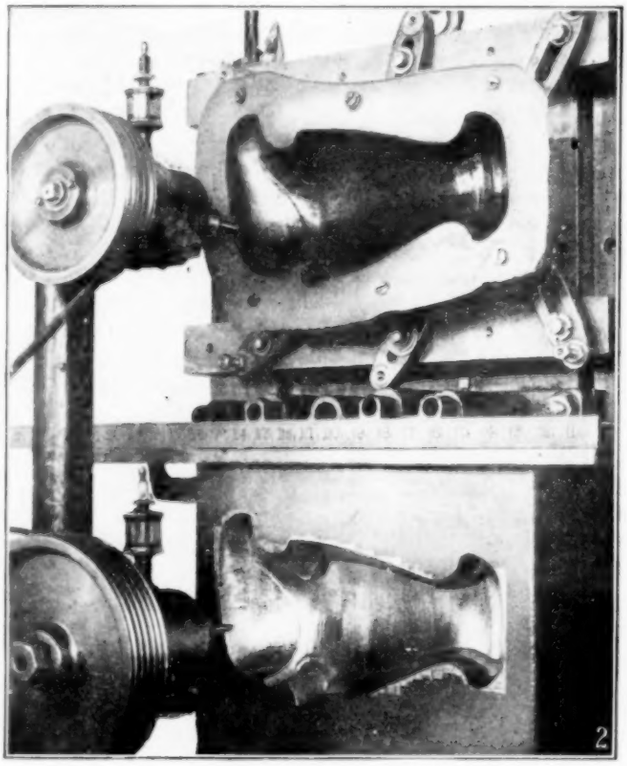


FIG. 2. SINKING A DIE FOR A METAL PITCHER

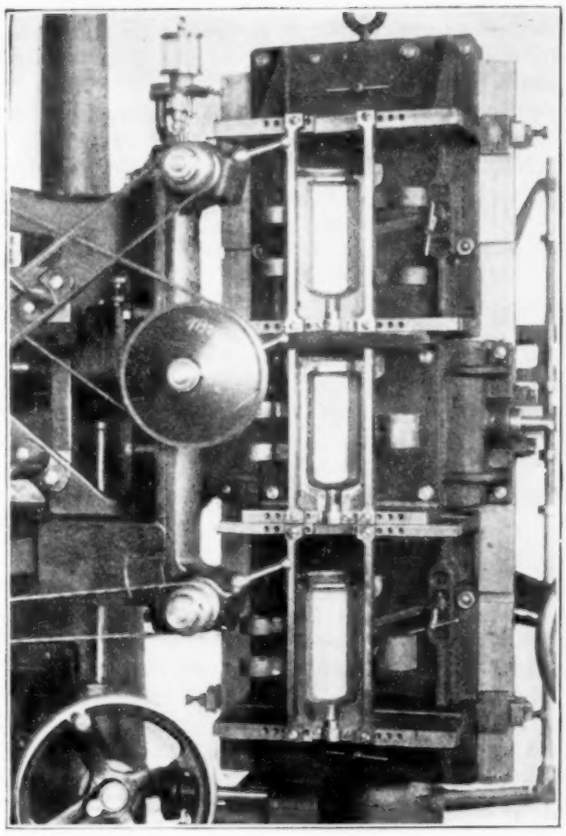


FIG. 3. SINKING BOTH HALVES OF A MOLD FROM ONE MASTER

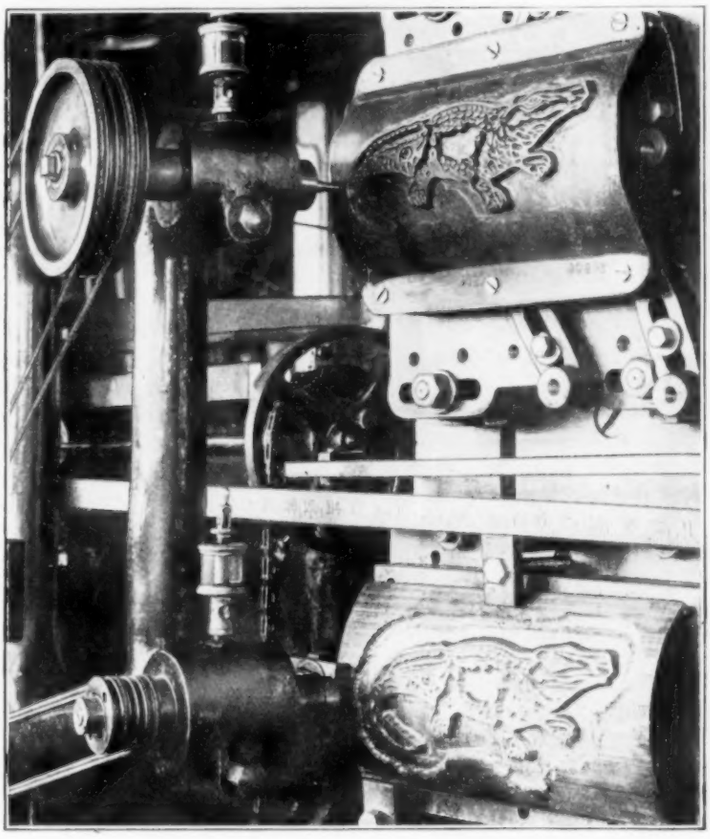


FIG. 4. METHOD OF SINKING A CURVED BRANDING DIE

two cutter spindles and to cut both halves of the mold at the same time, using a hand-cut mold section as a master. Fig. 3, illustrates a case of this kind. Here both halves of a bottle mold are being cut simultaneously. The master is shown in the center and the halves of the mold at the top and bottom respectively.

As an example of intricate work that has been done on this machine, Fig. 4 is shown. This is a close-

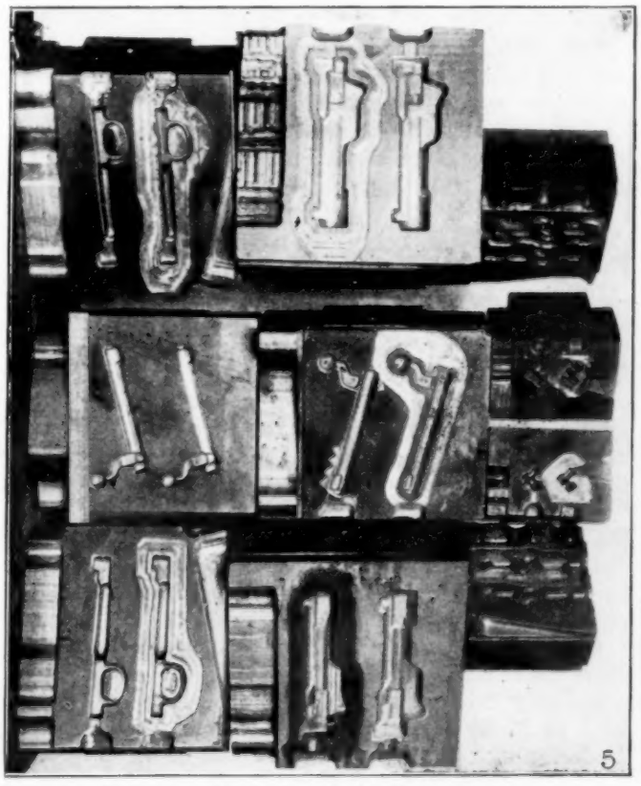


FIG. 5. GROUP OF FORGING DIES FOR RIFLE PARTS

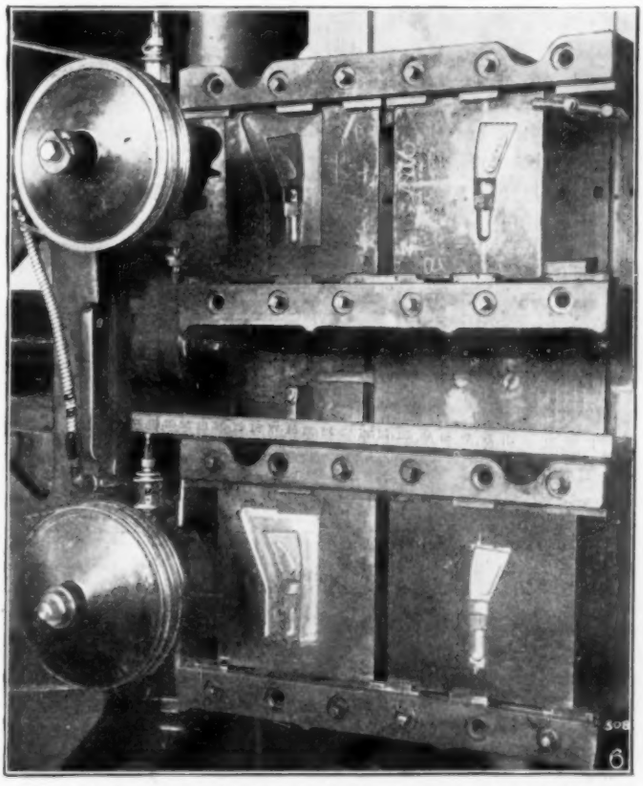


FIG. 6. FIXTURE FOR HOLDING TWO DIES AND TWO MASTERS

up view of a convex steel branding-die in the last stage of completion. Dies of this character are for use on cylinder printing presses for printing trade-marks on the tops or sides of wooden boxes.

Fig. 5 is an illustration of a number of forging dies for component parts of a military rifle, all of which were cut on this machine.

Fig. 6 illustrates a lately designed fixture in which two dies and two masters are equally and accurately clamped into position by drawing their faces forward against hardened and ground stops. Nearly all machine cut dies require a certain amount of hand finishing, though this, of course, varies with the character of the work and the individual requirements. In many cases the dies require only a little smoothing, but in any case the hand work required is relatively inexpensive and does not call for as much skill as does hand die sinking or mold cutting.

As will be noted from Fig. 1 the drive is by an electric motor through several round cotton belts running over grooved pulleys, the number of belts used depending on the power required to do the work.

The machine will accommodate a die block having a surface of 27 x 16 in. and a depth of 12 in.

For duplicating, existing dies may be used as masters while for original work, models or patterns may be made of wood or modeled in clay, plaster or wax. From such patterns permanent masters for use on the machine may be cast in iron or bronze.

The Value to Shop Students of Visits to Industrial Plants

By Victor A. Kottinger

Machine Shop Instructor, San Jose High School, San Jose, California

Class excursions of the vocational students to the leading manufacturing plants and commercial centers help to give the pupils a concrete knowledge of the industrial and commercial world. On these excursions, the boys can readily grasp some idea of the close relationship of the agricultural, industrial and commercial world. They can realize the value of invention in the progress of civilization, the relationship between labor-saving devices and competition, and the value of the organization of labor and capital.

During these industrial trips the boys are thrown in direct contact with the workers in their various occupations, and are brought to realize that an educated brain and hand have a greater economic value than mere physical force. They realize that knowledge is power, and return to their school studies with renewed interest and zeal. The dormant powers of the pupils are awakened and with this awakening comes a definite aim in life. Their eyes have been opened to a new world, in which they have an active part.

Stated briefly, the aims of the industrial excursions are (1) to give the pupils a closer connection between their regular school studies and the world of industry; (2) to awaken the dormant powers of the pupils, and thus aid them in performing the work to which they are adapted; (3) to aid the pupils to realize the value of unskilled, half-skilled, and skilled labor in the industrial and commercial world and thus enable them to recognize the importance of thorough preparation in their chosen field of labor. Upon the return of the class from industrial excursions any misunderstandings or hazy conceptions of the trip are cleared up by class discussion. These discussions are carried on in systematic and logical order, following a brief outline of the departments of the plants visited.

The pupils volunteer information which interests them most concerning that part of the department under discussion. The backward pupils are drawn out by well-directed questions, and the boys are given an opportunity to ask questions concerning any part of the department under discussion. Other pupils are encouraged to volunteer the information.

In order to find out how much knowledge has been assimilated the pupils are required to write compositions on all of the excursions. These compositions give the pupils a splendid opportunity to take notes, to make outlines of the subject, and to express their ideas in writing.

An Educational Aid in the Drafting Room

By P. A. Fredericks

It is a very difficult thing to teach beginners in drafting the value of care in minor details, and to teach a number of draftsmen to observe minor standards which have been determined upon as the correct method for that particular shop.

An aid in this direction is a bulletin board with the heading as shown in the illustration.

When the checker, or the chief, discovers an error in following out standard practice, methods of dimensioning, or any one of the hundred things which may be wrong with a drawing, the chief draftsman attaches a note of explanation to the blueprint and puts it on the bulletin board. After remaining there a week or so it is taken down and passed from man to man for direct observation; each man initials it as a record and passes it on, when it eventually reaches the files as a record.

This system supplements very effectively a book of standard practice that describes in detail the standards which are expected to be followed out, and another book of standard details that gives details of various interchangeable parts carried in stock by the firm, being therefore preferable for use on new designs.

On drawing 1 the chamfer to permit teeth of the sliding gear to engage was put on the wrong side The gear was hardened, making much extra expense

Drawing 2 shows a very common and very careless error. In retracing from the blueprint because of lost tracing the tracer filled in $1\frac{7}{8}$ in. instead of $\frac{7}{8}$ in. and failed to check even his few figures.

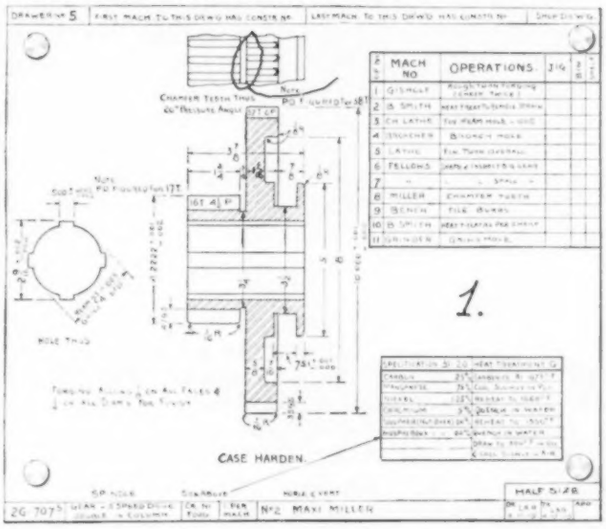
Drawing 3 is an instance of a hexagon drawn the wrong way, leaving a chance for turning the piece to $2\frac{3}{8}$ in. in diameter. It should be drawn as shown by the correction and dimensions changed to suit.

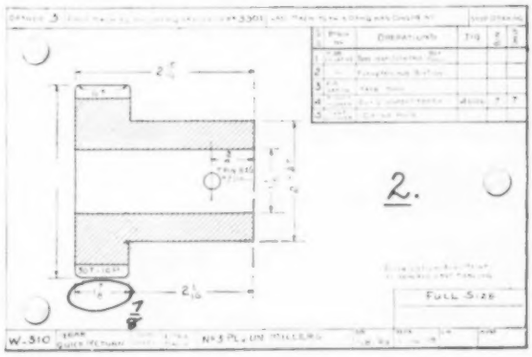
Drawing 4 caused spoiled work. The man turned the parts 1.498 in. in diameter because he did not notice the end view. It should have been drawn the other way round as per dotted lines. Similar mistakes often occur on hexagon work.

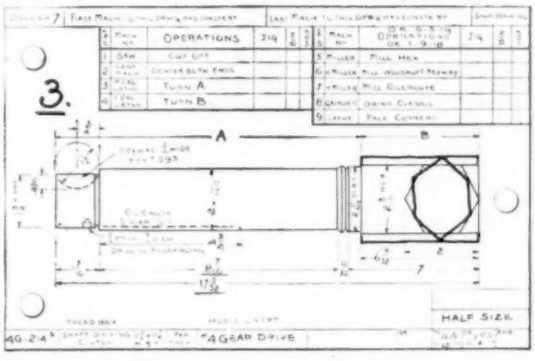
On drawing 5 the ball race is wrong side up. Since there is a force fit at *A*, revolving the shaft causes a rubbing friction at *B* and the bearing cuts either at *A* or *B*. If turned the other way up, as is intended in designing the bearing, there would be 0.005 to 0.010 in. clearance at *A* and it would work perfectly. Watch out where you put thrust faces on thrust ball races.

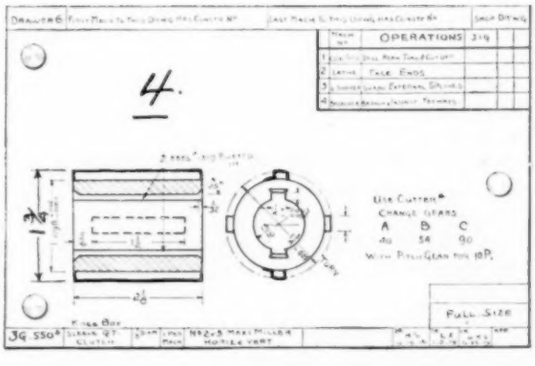
THESE DRAWINGS ARE WRONG

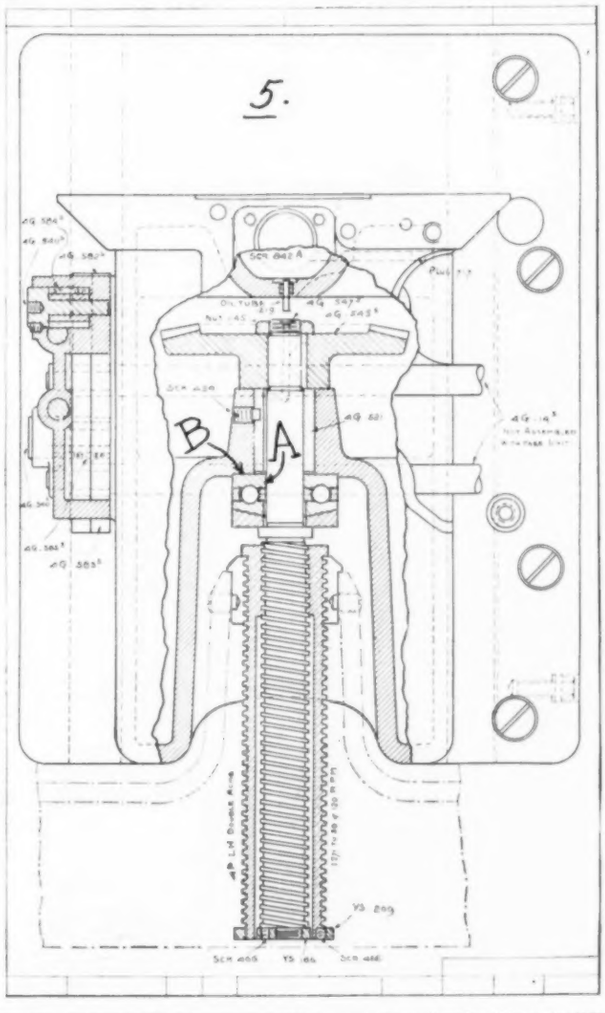
TAKE NOTE WHY AND AVOID SIMILAR ERRORS











A Machine for Boring Line Bearings

By J. V. HUNTER
Western Editor, *American Machinist*

This article describes the construction and method of operation of a machine used for boring and reaming the bearings of an automotive crankcase. The machine is typical of those used in the automotive industry, as it is designed for rapid production and can be loaded while a cut is being taken.

NUMBERS of special machines have been built for boring and reaming the line bearings of automotive engines, a good example being the machine shown in Fig. 1. This machine was made according to the specifications of the Bethlehem Motors Corp., Pottstown, Pa., in whose plant it is located. It was built by the Baush Machine Tool Co., Springfield, Mass., and equipped with special boring and reaming bars made by the Kelly Reamer Co., Cleveland, Ohio. The machine has a revolving fixture which permits the loading of a crankcase on one side of it while the boring operation is proceeding on the other. It will bore several different sizes of motor cases, a different fixture and boring bar being provided for each size. One of the cases is shown lying on top of the fixture in the illustration.

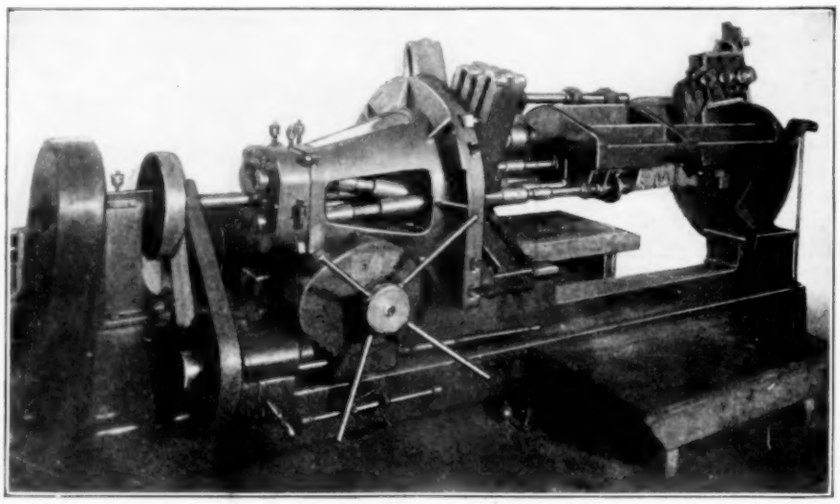


FIG. 1. SPECIAL LINE-BORING MACHINE FOR GAS-ENGINE CRANKCASES

The fixture is shown revolved 90 deg. from its working position in Fig. 2 to give a better idea of the construction and the method of operation. Fig. 3 shows the work removed and the reamer bars slipped back into position in their bearing brackets on the fixture.

The crankcases are of cast iron and two cuts are taken through them in the boring machine, finishing a case in about six minutes. The first case to be bored is placed on the fixture with the roughing cutters in place in the bars, then after it has been bored and while the case on the other side of the fixture is being roughed, the operator puts the finishing cutters in the boring bars in the case previously roughed. A similar change is made with cutters of the second crankcase while the finishing cutters are boring the first one; and thus only one setting of the work is required for both roughing and finishing.

The spindle speeds are governed by the ratios of the gears in the head driving the spindle and they range from 56 r.p.m. for the slowest bar in the 3-in. starter hole to 84 r.p.m. for the fastest bar in the 1¾-in. pump-shaft hole. The spindle speed is governed by the forward movement of the spindle head. This is so driven that it gives roughing and finishing feeds for the slowest bar of 214 and 40 rev. to 1 in. of travel respectively (0.00467 and 0.025 in. per rev.), and for the fastest bar of 320 and 60 rev. per inch of travel respectively

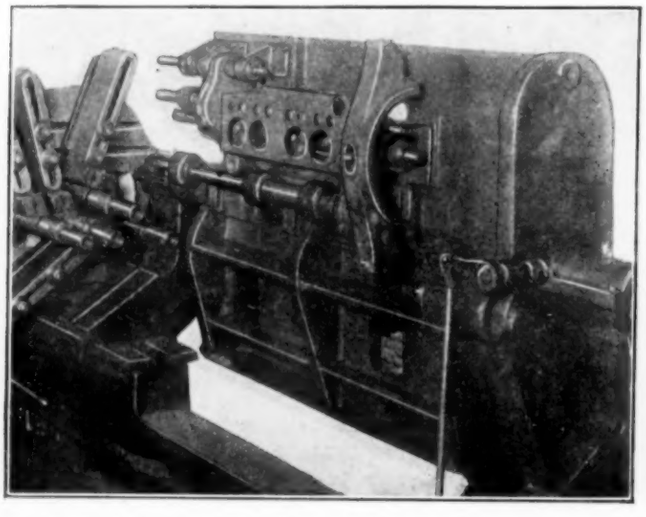


FIG. 2. SHOWING METHOD OF HOLDING THE CASES ON FIXTURE

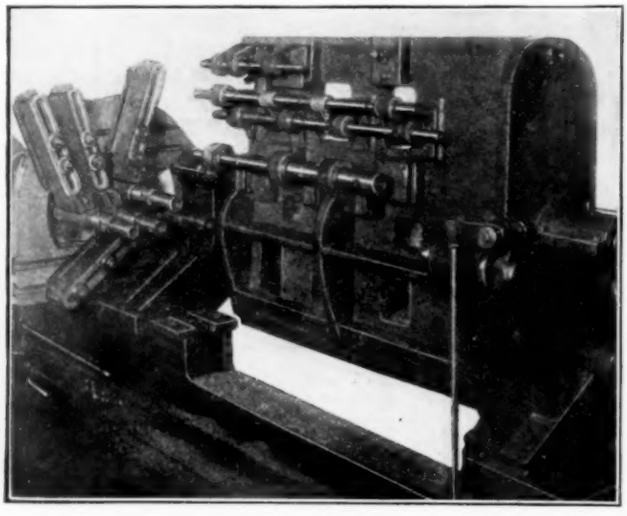


FIG. 3. FIXTURE WITH REAMING BARS IN PLACE

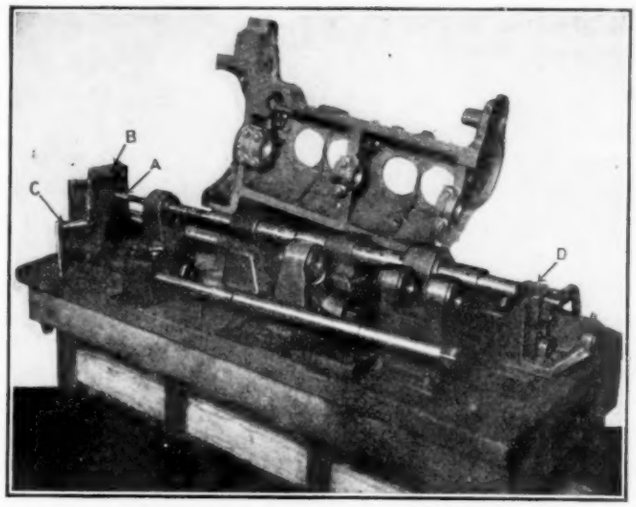


FIG. 4. SPECIAL FIXTURE FOR HAND REAMING THE BEARINGS

(0.0031 and 0.0166 in. per rev.). The bars are driven through universal joints, so that positive alignment of them with the drivers is not necessary.

A third cut is later taken through the bearings of the cases to finish them to still greater accuracy, and for this operation, which corresponds to hand reaming, the fixture shown in Fig. 4 has been devised. Special reamer bars are used for the work, they being guided in the fixture by hardened bushings in the same manner as on the power boring machine. A pneumatic drill motor is used for driving the bars. The large bars are given a uniform rate of feed, the threaded pilot-stud *A* on the forward end being inserted in the split bracket *B*, which is opened to receive the threaded section and then held close by the lever and spring *C*. A similar device *D* on the other end of the fixture feeds the other large boring bar, which is driven from the left end.

A Few Reasons Why Industrial Progress Is Slow

A splendid analysis outlining the causes for the slow progress of domestic business, is given by L. F. Loree, president of the Delaware and Hudson Co., in the Ninetieth Annual Report to Stockholders, published in the *Railway Age*, of April 30, 1920, from which the following is an extract:

The chief domestic obstacles to the resumption of progress are: (1) The extremely low purchasing power of money; (2) continued absorption of liquid capital of the Federal Government, and (3) excessive and badly adjusted taxation.

The average wholesale prices of all commodities in 1919 were 212 per cent compared with those of 1913, or an increase of 112 per cent. The total amount of money in circulation during the same periods, gold, gold certificates, silver and currency, was $3,363,738,449 and $5,960,382,866 (Jan. 1, 1920) respectively, an increase of only about 77 per cent. The statistics of bank clearings show, however, that the work done by the average monetary unit has been greatly increased, the comparison of total bank clearings being $50.48 and $71.48 for 1913 and 1919, these figures representing the average per $1 of money in circulation, which suggests the operation of an impulse toward higher prices other than the volume of money in use.

Of the total resources of the twelve Federal Reserve Banks, bills on hand on March 14, 1919, amounted to 40.94 per cent of the total resources and on March 12, 1910, they reached 47.78 per cent. Of these bills on hand there were secured, by Government war obligations, 79.23 per cent and 51.78 per cent respectively.

The foregoing shows progress mainly in the accumulation of resources and it is evident that a reduction in the year of but 10.95 per cent in the loans received by Federal war obligations is unsatisfactory. To the extent that the resources of these banks continue to be used to finance the Government they are withdrawn from the commercial field and the normal utility of the Federal Reserve system is impaired.

Taxation impinging principally upon potential saving has prevented the liquidation of a large proportion of these loans and has congealed assets that ought to be, and were intended to be, available for business purposes. Indeed, from whatever angle the present system of Federal taxation is approached, it is found to work badly, to penalize frugality and saving, to promote profligate and wasteful expenditure of capital and the normal course of industrial development. The Secretary of the Treasury of the United States has recommended changes which would relieve some of the most depressing features of the system, including the repeal of the "excess profits" tax and moderation of the surtaxes on individual incomes.

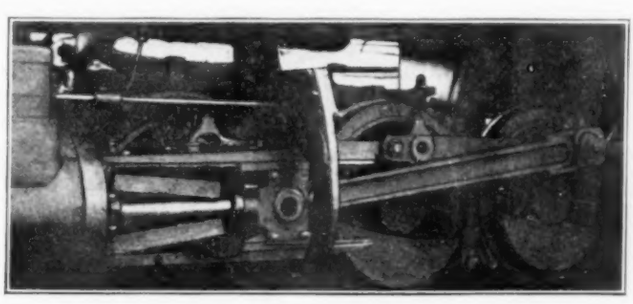
Easy Method of Disconnecting a Main Rod

BY HARRY BOHAM

Trouble is sometimes experienced in the roundhouse by reason of the front end of a locomotive main rod sticking in the crosshead when an attempt is made to disconnect it. It is caused by pieces of the sides of the rod, or of the inside of the crosshead, against which the rod oscillates, being torn off and wedged into the holes thus formed. The crosshead can not be loosened by prying or jacking or by other easily practicable means. excepting to remove the top guide bar and crosshead gib and then spread the crosshead with a wedge.

The illustration shows a method of blocking by which we are enabled to pull out the rod by steam pressure. In the engine shown the brakes are set, the reverse lever dropped into the forward motion, and the engine given a little steam; the crosshead comes out with a bang against the two hard wood blocks.

We leave about one or two inches of space between the crosshead and the blocks so there is no danger of breaking a cylinder head. This is a quick method, and is sure to bring the crosshead out.



DISCONNECTING A LOCOMOTIVE MAIN ROD BY STEAM PRESSURE

A Difficult Piece of Press Work

By FRANK A. STANLEY

The example of press work shown here is worthy of examination, as the required shape of the piece rendered its handling very awkward. The photographs show clearly the sequence of the operations and the dies used in cutting and bending.

THE sheet-steel piece, in Fig. 1 herewith, is a short tube of rectangular cross-section, but tapering from end to end and having numerous ears and flanges at various points along its contour. Several sets of press tools are required in its production, these being illustrated in Figs. 2, 4 and 5, and the flat blank produced in the dies being shown in Fig. 3.

The blank is struck from steel stock 0.062 in. thick. The dies, at the left in Fig. 2, are a set of tandem

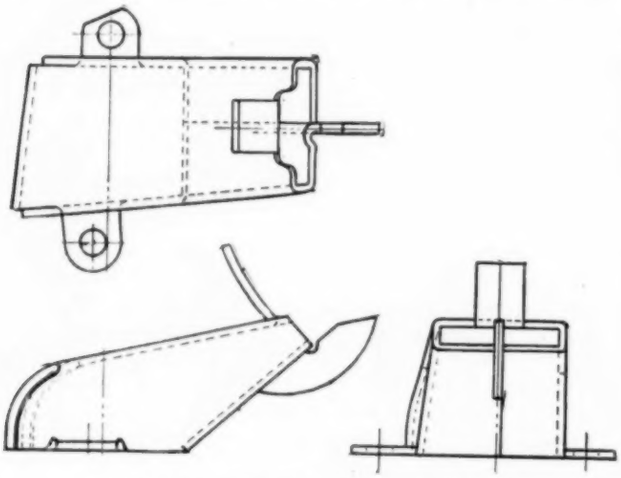


FIG. 1. DETAILS OF THE FORMED PIECE

tools, which at the first stroke pierce certain holes and openings, while the next position of the work and stroke of the press produce the blank shown in Fig. 3. The two round holes pierced by these dies are for the openings through the two small ears at the sides of the blank. In addition to the two round piercing punches there are four irregular punches for forming as many openings before blanking. These punches are really trimming tools in that they cut out the metal along the sides of the projections *A* and *B*, Fig. 3, and the adjoining surfaces in each direction, thus simplifying the work of the blanking die and assuring close accuracy at the points indicated.

The Bending Operations

The next operation is performed in the tools at the right in Fig. 2. These dies locate the blank by the important projections along its contour and at one stroke fold or bend up the ears *C* and *D*, referring to Fig. 3, and the hooked-shaped projection *E*, all of which must stand at right angles to the flat body of the blank. In this case the nest and the forming edges of the die are all made of separate blocks of steel located accurately on the die base by dowels and fastened from the upper side by fil'ister-head screws.

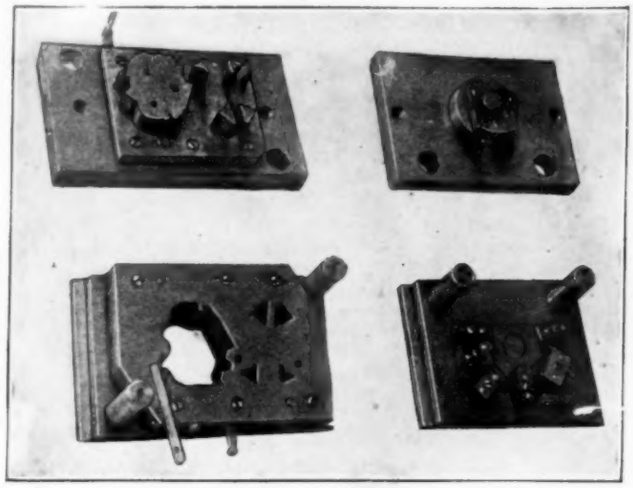


FIG. 2. THE FIRST AND SECOND OPERATION TOOLS

The next operation consists in forming along the dotted lines indicated in Fig. 3, thus throwing up the bottom walls *F* and *G* at right angles to the remaining triangular-shaped portion of the blank. The bending dies for this operation are at the left in Fig. 4, and, as there represented, are triangular in outline, with suitable nesting plates on the surface and with clearance holes in the die proper for the reception of the projections already bent up in the forming operation just completed.

The next operation, performed with the tools at the right in Fig. 4, is the forming down of the side walls and curved end at the back of the work. (See Fig. 1.) The forming punch with this set of tools is in the shape of a hook which, upon pressing the blank down into the forming-die opening, allows the work to fold up and almost completely enclose the hook punch itself, except for the shank by which it is attached to the

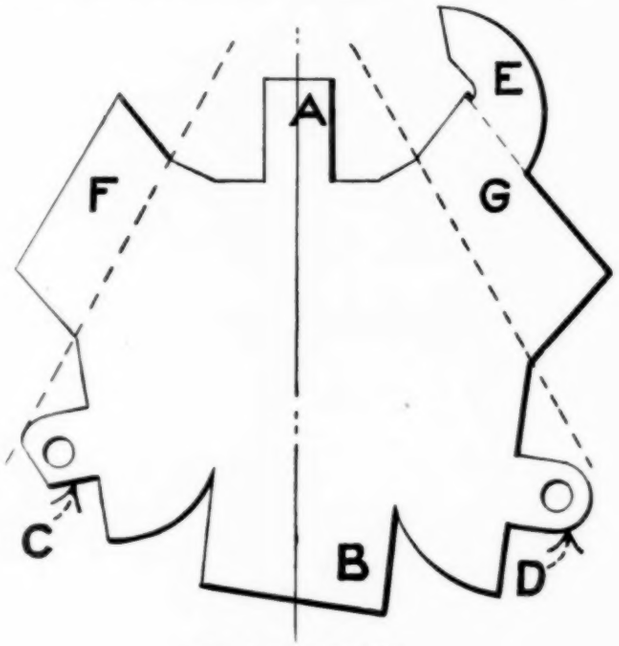


FIG. 3. THE BLANK

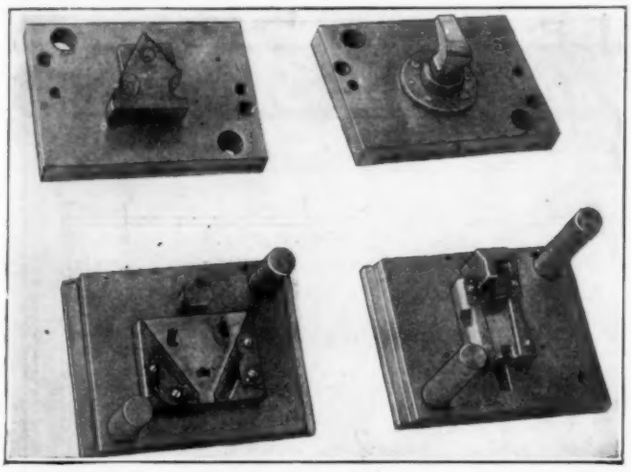


FIG. 4. TWO SETS OF FORMING AND BENDING TOOLS

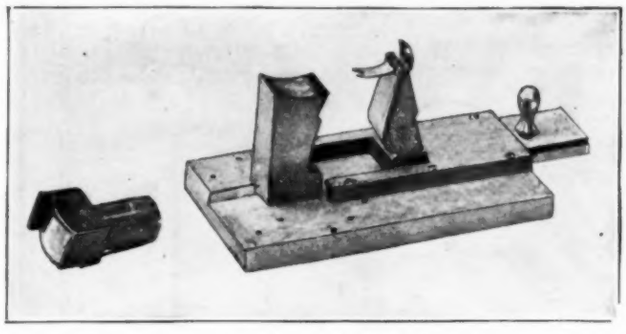


FIG. 5. THE FINISH FORMING DIES

die block. This punch, by the way, is worked down from a squared shank which is provided with a circular flange or seat by which it is fixed fast to the head.

The Final Forming Operations

This operation brings the work to a point where it is completed so far as the tapered form is concerned, but the rectangular projection *A*, Fig. 3, has still to be formed and bent to the desired angle and degree of curvature. For this operation the dies in Fig. 5 are used. The tool here shown is really a forming fixture having a movable carrier for the work, which is mounted upon a taper post, one of the pieces being shown in position. The post is attached to the carrier, which is in the form of a slide controlled by the handle at the right. This arrangement allows the operator to place the work in position and slide it under the punch without difficulty or delay. The punch is seen at the left. When it descends it bends the projection on the work down into the concave seat on the die block and sets it at the exact angle required with the walls of the work. The part made with these tools is a chute used on the coin machine manufactured by the American Coin Register Co., Oakland, Cal.

Campaign for Better Oiling

By W. Burr Bennett
President, Wayne Engineering Co., Honesdale, Pa.

Some time ago the executives of the plant under consideration realized that the repairs and replacements on their machine tools and equipment were entirely too large. An investigation showed that the lubrication was at fault. Although all machines were equipped with oil cups and holes for lubricating and oil cans and oil were plentifully provided, actually less than 10 per cent of the men gave the equipment under their charge regular and thorough oiling. It should be explained here that the maintenance department took care of all power-transmission apparatus and its lubrication, up to and including the countershafts, and that no fault was found with their attention to oiling.

Apparently, it was a case either of putting the lubrication of machinery and tools in the hands of the maintenance department, or of conducting an intensive educational campaign among the shop men. Due consideration showed the first of these solutions to be inadvisable. Accordingly a plan was outlined with the object of constantly bringing before each operator the need for attention to this matter and its direct relation to his own pay envelope.

There were four readily available ways of getting the message to the men: First, by direct coaching from the different foremen; Second, by notices posted on the machines; Third, by inserts in the pay envelope; and Fourth by notices on the bulletin boards. Supplementary to these methods, all shop papers such as time cards, shop orders, and requisitions were stamped with the legend: "Lubrication Is Important. Have You Oiled Your Machine Today?"

During the first week of the campaign, personal talks were given by the foremen and department heads to their men in order to show to them both the necessity for more care in the lubrication of machinery, and that the effect of having a machine shut down because of a dry bearing was to stop their work and thus cut the amount of their pay. It is to the credit of these foremen that they carried out their work so well that an improvement was noticed almost at once in the lubrication of equipment.

The second method was put into effect on Monday morning of the second week. When the men appeared on the job they found the following notice attached to all equipment: "STOP . . . THINK. Don't start work on this machine before you have properly oiled and carefully lubricated all parts. Don't forget to oil the jig, fixture, or vise you are using."

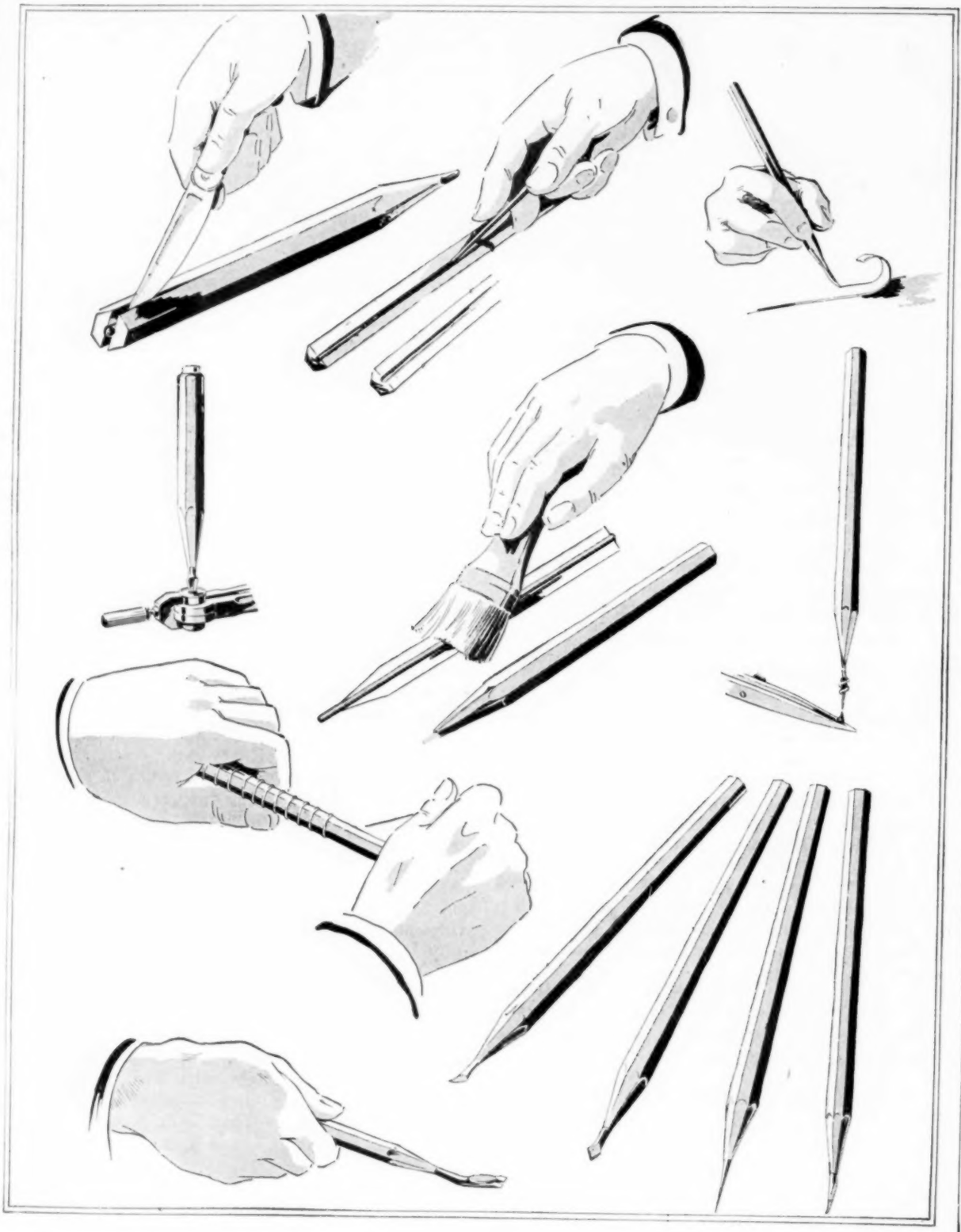
The third method was put into effect by providing inserts in the pay envelopes calling attention to the campaign that was going on and telling how much each person could help by taking proper care in lubricating his own equipment. The fourth method followed this and consisted of posting on the bulletin boards complete explanatory letters about the campaign and notices which read: "Oil Up—Lubricate Your Machine Often and Carefully. Watch both Production and Your Pay Envelope Increase."

By this time the improvement was marked and it was deemed desirable to end the campaign, with the exception of such features as periodic instructions and the use of the stamp on shop papers, which were made permanent. Therefore, the next week the men found the following note inserted in their pay envelope as a recognition of their co-operation and an acknowledgement that the results were satisfactory: "This Pay Was Made Possible by Your Careful Attention to the Oiling of Machinery. Thank You. Keep Up the Good Work."

It is interesting to note that the whole campaign required but very little effort on the part of the individuals directing it, although the results were large, dry and burnt bearings having practically disappeared. However, the consumption of oil increased about 50 per cent, but even this was cheaper than replacing metal.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



Elements of Gage Making—IX

By C. A. MACREADY*

The accurate grinding of radii to the points of tangency is not a difficult matter if the proper fixtures are available. Such fixtures are described in this article together with instructions for their use.

(*Part VIII was published on page* 1101, *Vol.* 51.)

THE following way of grinding radii is often more convenient than by the use of a toolpost grinder or the grinding and milling attachment illustrated in Fig. 106. The plate *A* in Fig. 113 is made of ¼ x 4 in. flat ground stock, of a length which is convenient to swing the work. It is held by a screw *C* the head of which is flush with the top of the plate *A*, and a thin nut in the toolpost slot. The several different

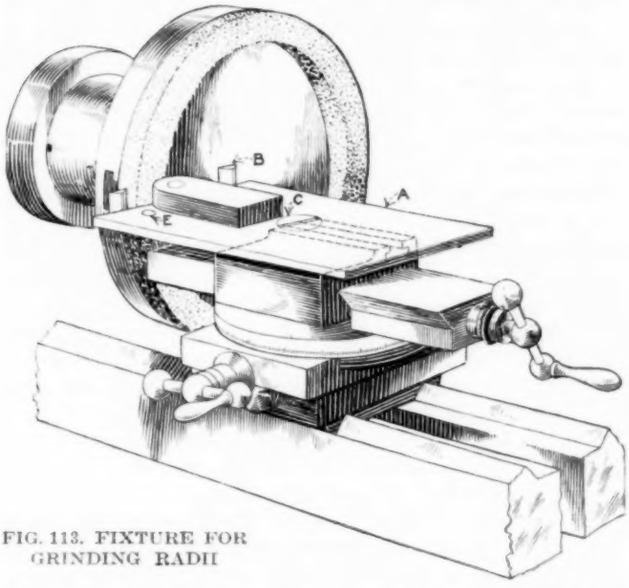


FIG. 113. FIXTURE FOR GRINDING RADII

holes *E* are placed to suit the radii wanted. The sizes of the holes will be governed by the length of the radii. They are often comparatively large as the work is frequently held by an auxiliary piece or adapter. This adapter if properly made serves as a base to check the radii. The plate *A* replacing the toolpost of a bench lathe and adjusted square vertically to the face of a cup wheel becomes a bed upon which the work is swung horizontally, using the proper hole for the center of the radius. The graduations upon the dial of the longitudinal screw are used when feeding up to the face of the cup wheel. The stops *BB* on the wheel end of the plate *A* will keep the sides of the gage from contact with the face of the wheel when grinding radii tangent to the sides of the gage. They should be nearly parallel to the face of the wheel and adjustable for different widths of gages. The following examples of the use of the plate *A*, and a few examples of adapters will make this way of grinding radii plain; Fig. 114 illustrates one of many gages that have been made by the use of this method.

*Prepared for the author's forthcoming book, Elements of Gage Making.

The gage *A*, gages two slots. It also gages a depth and two radii on the end *B*. The narrow gaging member *G* must be central with the large one *H* and parallel to it. The centers of the arcs are coincident making the required depth the difference in length of the radii. This gage provides an excellent example for study

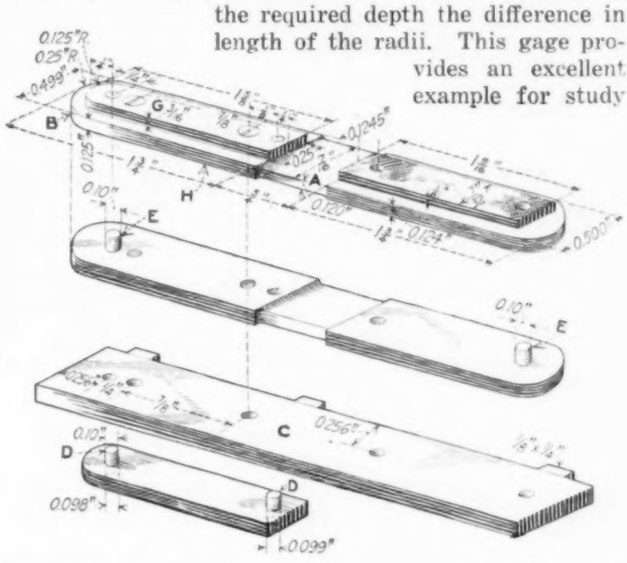
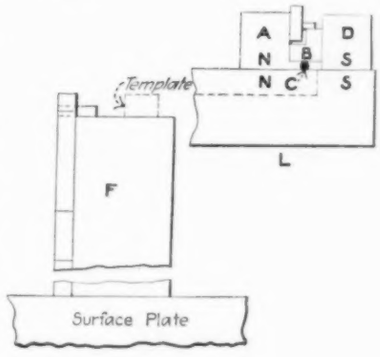


FIG. 115. A GAGE WITH THE RADIUS OFF CENTER

while determining how it should be made. The drawing shows the sides to be parallel but with a difference of 0.001 in. in width. The thickness of the broad part also differs 0.001 in., which shows that there is a maximum 0.0005 in. that is allowed for the slot in the work to be out of the center of the 0.500 in., the narrow part of the gage fitting the slot properly, as this is the important assembling point for the functioning of the parts.



As the end dowel-pin holes are the centers of the radii, they are the ones used to position the work for rough grinding the sides of the wide part of the gage, 0.500 in. Both dowel-pin holes in the 0.250 in. piece are used as locating points to equalize the sides of the piece. The checked narrow part can be ignored as it has plenty of clearance and acts as a grip when the gage is being used at the other end.

If there are more than one of these gages to be made a simple jig like *C* will save time, otherwise the holes, after being drilled in *A*,

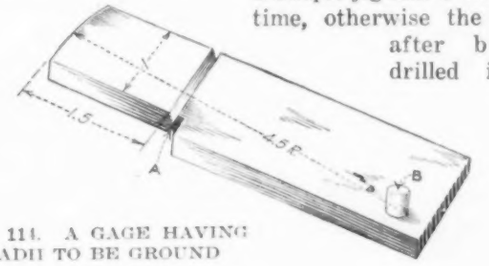


FIG. 114. A GAGE HAVING RADII TO BE GROUND

can be transferred from *A* to the top piece *G*, as it is not hardened. The holes in each hardened piece being the same center to center distance in their soft state usually will extend to their center distance when hardened. When the 0.250 in. pieces are drilled in the jig *C* the difference in their width and length from the 0.500 in.

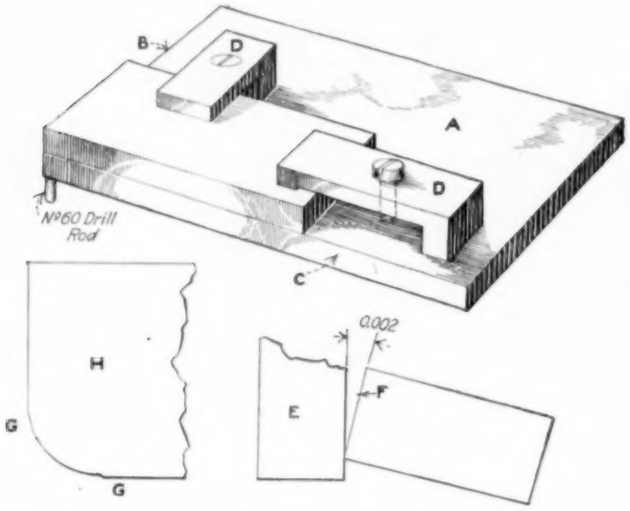


FIG. 116. ADAPTER FOR GRINDING AN OFF CENTER RADIUS WHEN THERE ARE NO HOLES IN THE WORK

pieces is made up with packing pieces. As these gages can be finished up independently of the other end, 0.012 in. on their sides and ends and 0.008 in. on their faces will be enough excess metal to leave for grinding.

After being hardened and heated sufficiently to melt soft solder they are rough ground parallel, leaving 0.001 in. for finishing on the 0.125 in. thickness. The sides of these pieces are not ground at this time. The thickness of the top pieces, given as $\frac{7}{16}$ in., not being important, they are finished. From now on they must be carried in pairs, that is, a top piece, 0.250 wide, is rough doweled to the lower gage, then attached to it with screws; the screws must be an easy fit in the thread, otherwise they will distort the thin piece or lower part of the gage, when tightened. The temporary dowels are now removed and the dowel-pin holes are lapped out using a drilling-machine spindle to rotate the lap. The use of a drilling-machine table if it is square with the spindle will usually correct the out of squareness due to grinding the pieces without wholly correcting the hardening distortions. As all the holes are lapped, one at a time, with the same size lap they will be approximately the same size. This is not necessary, but the bodies of the dowel pins which extend out from the gage should be of one size as shown in *D* and *E*. As the extending parts of these dowels are used to bed upon when grinding a surface parallel to them, the difference in their diameters will produce surfaces out of parallel an amount equal to twice the difference of their diameters. If there is a difference of 0.0002 in. the sides of the 0.25 in. piece will be out of parallel 0.0004 in. The four extending ends of the dowels which are used for the radii centers, if of one size, save readjusting the height gage when measurements are taken. Diagram *F* shows the work swinging upon the dowel pin, which rests upon an angle iron when measuring the distance from the center of the radius. The pieces with the temporary dowels in place as illustrated at *D* and *E* are now ground upon one of their sides using the principle shown in Fig. 71 and reproduced at *L*. The part *B* is the bed for the dowels to rest upon, connecting them with the S polepiece *D* and drill rod *C*. The 0.250 in. pieces are reversed and ground upon the opposite edges. This proves the diameter of the dowel pins. As the error should be slight it is corrected by lapping one side of the piece an amount equal to one-half of the error, this lapped surface was then used to bed upon the chuck when grinding the opposite side. When equalizing the sides from the dowel pins, use the dowel pin that will be used for the center of the radius in *E*, Fig. 114, as the sides of the 0.250 in. are the governing surfaces instead of the dowel pins when grinding the sides of the lower gage, to the 0.499 in. dimension, using the fixture *L*.

Before removing the dowel pins they should be used for the centers of the radii, a hole having been drilled in the plate *A* to receive them, the stops are now set to keep the sides of the gages from touching the face of the wheel. The dial is used to show the amount being removed, the correct radius is measured with a height gage, as shown at *F*, or by comparing with a templet and using an indicator.

The segments of circles are easily made with the fixture, Fig. 114. Fig. 115 shows a segment that is off center as dimensioned. A piece of flat ground stock is taken, which is long and wide enough to contain the center required. This piece of stock is nicked as shown at *A* to be broken off at this line after inspection of the radius and the location of the 1.0 in. dimension. This style of gage or templet is not machined very accurately in its soft state as it can be very easily ground after hardening to the desired dimensions by measuring from the drill rod *B* upon which it swings.

The adapter illustrated in Fig. 116, is one used when no holes are permitted in the gage. After the pivot pin, in this case No. 60 drill rod, is in place the edges *BC* of the adapter *A* are ground square to each other and the distance required from the center of the pivot for the radius. The work is placed in line with the edges *B* and *C* and held there with straps *DD*. The diagram *E* shows a plan view of the precautions taken to avoid striking the sides of the gage. The stops are adjusted to hold the work and adapter at a slight angle as shown at *F*. The face of the wheel should not be used too long in one spot as there will be a slight groove worn in it. Using different places on the face of the wheel will reduce the angle of clearance at *F* to a very small one so that the slight error shown exaggerated at *GG*, in diagram *H* can be corrected with

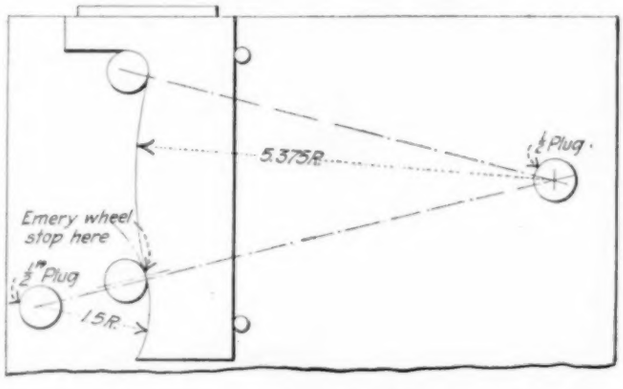


FIG. 117. DIAGRAM SHOWING DETERMINATION OF POINTS OF TANGENCY

an oilstone, or by lapping to a disk template. As all measurements are taken from a vertical point over the pivot this error will not interfere with measurements. The point of tangency if placed upon the gage when grinding radii facilitates the adjusting of the stops for the length of arc being ground. Fig. 117 illustrates a way of determining this point when the engine lathe is used to swing the work attached to the faceplate.

A line drawn through the center of the circles passes through the point of tangency and a line drawn upon the coppered surface of the gage to indicate where the wheel finishes, permits the arc-length control-stops upon the faceplate to be adjusted very accurately. This leaves very little to stone or lap for continuing the arc at each end. The male-arc templet if required can be made with the fixture illustrated in Fig. 113, and the female templet is ground out by using an internal grinding fixture in the lathe, should there be no internal grinding machine.

When lapping local spots and surfaces, which often has to be done on gages, the laps can be controlled easily with the pointed lap guide *A* in Fig. 118. The laps *B* and *C* show the controlling points, which are simply punch marks. These punch marks are placed to apply pressure where desired. Taking the depression in the gage *D* as an example, the pressure applied to a punch mark in the lap *B* or *C* will so distribute the lapping action that if only one side of the bottom requires to be lapped the pressure can be applied there and its surface caused to blend into the surface of the depression. This is made possible by locating the punch marks at varying distances from the center of the lap, wherever they are required.

This way of applying lapping pressure to gages of narrow cross section like gage *E* will overcome the rocking effect that often occurs when the gage overhangs the lap. The index finger and thumb are used merely to give the sweeping motion, the downward pressure being applied through the rod *A* held in the other hand.

When lapping parallel surfaces required in snap gages the adjustable taper wedges *F* and *G* in Fig. 119 are used. The taper wedge *F* is listed by the L. S. Starrett Co., which makes several sizes. The dotted lines indicate extensions that are soldered upon the tapered wedge, then ground parallel to each other. As these laps are only used to locate the high spots and finish-lap to size, the side overhang if not excessive will not be objectionable. When lapping snap gages that have the "Max" and "Min" on one surface, as shown at *H* in Fig. 118, the continuous surface is first finished to a plane surface using the pointed holder and laps similar to *BC*. The taper wedge is charged with abrasive upon only one of its surfaces, the other surface free from abrasive is in contact with the finished surface of the snap gage. All lapping to size is done upon the "Max" and "Min" surfaces. When the jaws of snap gages are parallel both sides of the lap are charged with abrasive.

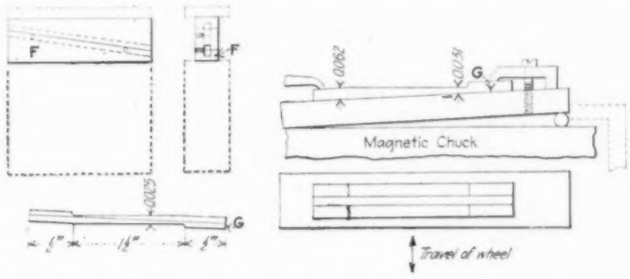


FIG. 119. TOOLS FOR LAPPING SNAP GAGES

The taper wedge shown in *G* is made of soft sheet steel. Two strips are attached to a flat plate by straps. A piece of drill rod, of the required diameter to give the desired taper to the lap, is placed against the back pole of the magnetic chuck. The flat plate placed upon the drill rod allows the plate to be removed and the thickness of the lap measured and then replaced to the same position if more stock is required to be removed. There will be considerable distortion when rough grinding these laps but if they are stoned as described in Article VI, before the finish cuts are taken they can be produced very accurately. When using these thin laps do not try to *push* them through the slot. Always *pull* them through each way, using an up and down motion.

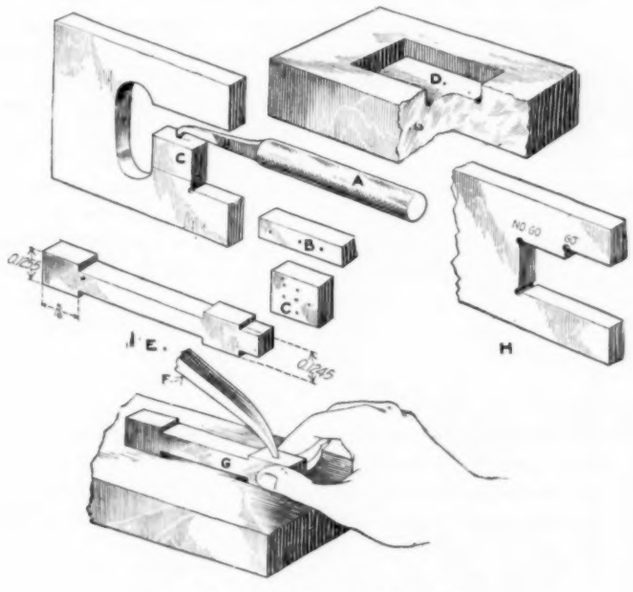


FIG. 118. METHODS OF LAPPING

What Is a High-Grade Machine?

BY FRANCIS W. SHAW
Manchester, England

How simple the question and how difficult the answer! I have thought considerably on the matter and I believe that the answer is still far off, although I seem to have no difficulty in judging to my own satisfaction the productions with which I am familiar.

The Ford car, for instance, I should never think of placing in the highest grade, or even in the moderate grade. The Rolls-Royce, however, would classify itself in the very highest grade. Yet, power for power, cost for cost, the Ford is undoubtedly the better value. For the comparative abuse it will stand, it is far ahead of the costlier car. What is it, then, that compels this grading difference? Finish, comfort, appearance? Perhaps so, but after all, surely it would be more logical to classify according to suitability to purpose. If we so classified the two cars, they would both fall into the highest grade.

Now let us consider machine tools, which are more within the writer's knowledge. Years ago I had the experience and the pleasure of operating two lathes at

the same time. One was a high-grade, so-called, English machine, the other was an American machine with a moderate reputation. Both were intended for accurate work. The English machine was heavier than the American, its price proportionately larger.

The Writer's Experience

This was my experience: On the vast majority of work the output from the American machine was far ahead of that from the English. Why? The English machine was more cumbersome to handle. To move the saddle along the bed was more fatiguing. To get the tool to the proper cutting height and in a convenient position for cutting, occupied more time, for the tool-slide was cursed with the four-stud arrangement, in which one or more studs prevented the tool from being fixed just where it would best do the job. The saddle was broader, and that often limited the traverse along the bed, making it necessary to move the tool from one side of the toolrest to the other.

Furthermore, when it came to getting metal away rapidly the English machine, though the stronger built, was out of it entirely, although had our cutting tools been of the carbon-steel variety perhaps the case would have been different. It was utterly impossible to get high spindle speeds with sufficiently fine feeds on the English lathe. Bearings ran hot at very moderate speeds. Perhaps some of the difference was due to the American lathe spindle running in babbitt-metal bearings. The makers of the English lathe seemed to make a point of the bearings being of the best phosphor-bronze—as most do even to this day. In this connection it is perhaps worth pointing out, that after several years of service, it was possible to tighten the spindle of the American lathe by a squeeze at the capscrews, but there seemed to have been no wear at all. (An English toolmaker who recently replaced bronze bearings with babbitt-steel bearings was enabled to put up the highest spindle speed from 300 r.p.m. to 500 r.p.m. after the change.)

Marks of Quality in English Machines

But there were many points which some would claim as virtues in the English machine. Materials were generally harder. One could hit the lathe bed with a spanner without bruising it. An extra pound pull at a lever or spanner would not fracture a bolt. The headstock caps were secured with large-diameter studs and nuts, whereas the American manufacturer had contented himself with small cheese-head screws. You could even clear the cuttings from a file by rapping it on the tailstock without shattering the filling and spoiling the paint. The castings themselves were smoother in the English machine and filling was therefore not so necessary for finish.

Now in the hands of English workmen accustomed to English machines the English lathe would undoubtedly have given more satisfaction than the American. The writer, however, had proved to himself the value of the high speeds and fine feeds over low speeds and coarse feeds, and as a consequence could appreciate the differences in the two machines. This is a case from which it is impossible to draw a definite conclusion. From my own experience, the characterization would be: American lathe, high-grade; English lathe, second-grade.

Many English workmen with different experience would reverse the classification.

At one time when a German woodworker's vise had just arrived in our shop our experts immediately placed it in the lowest possible category, for it was a thoroughly ram-shackle affair. Materials were rough and badly finished; there was a slackness of fit everywhere. A wire nail, bent over, formed a retainer for a spring; there was not a bit of polish anywhere and only one coat of dull gray paint. In use, however, it was a perfect tool.

Now all these points, which to our experts were deemed adverse, to the writer appeared meritorious. A wire-nail used at a point where it would not be seen when the vise was in service, since it had afforded a means of reducing the cost, constituted a feature of real merit.

Our way of securing the spring would have been by a screwed thimble or something equally expensive. Our method of setting high-gradeness—trimming, painting elaborately and polishing—would have doubled the cost and compelled the woodworker to have bought and used a far less efficient vise. Here perfection in use for the lowest cost were the features constituting high-gradeness—another example of the Ford principle.

Workmanship and Its Utility

Sloppy fits come under the ban of some engineers. Here is an instance where they improved a high-grade machine. One unit of a machine was of complex construction. Shafts ran in hollow shafts, which in turn ran in thin bronze bushes driven in position. There were numerous bearings, and all parts were made to standard limits quite suitable for most ordinary work.

Not unnaturally, when the parts were assembled, little dis-alignments here and there, the collapse of bushes in driving in, small eccentricities in cylindrical parts, together resulted in all running fits coming tight. At the running test numerous troubles were encountered. After a short run the driving belt would come off with a squeak—something had seized. The fitters then paid the machine a visit, dismantled the seized parts, often with difficulty, scraped bearings, had shafts re-ground and so on. And not infrequently, after re-assembling the trouble occurred again, sometimes several times. By degrees, not a few thousandths freedom, additional to the amount presumed correct, were obtained.

This trouble went on for several months, until some bright mind suggested that, since by correction additional play was secured, it might be as well to start out with the extra freedom. Following this hint, a different standard of running fits with larger allowances was introduced, and the trouble practically vanished. Yet, when the assemblers noted the shake of part on part, when these were being assembled, they expressed the opinion that the job was spoiled, and several thought that the proper way to a solution lay in the scraping of part to part.

Since time has proved the cure to be good, would one be justified in claiming for the machine equal perfection of grade to those formerly carefully fitted? I believe he would, yet there are many mechanics who would claim the opposite, despite the fact that the alternative would have involved the expenditure of labor to no good ultimate purpose. The whole question can only be answered by first replying to the question: "What do we mean by high-grade?" Define that term—the definition may be diverse—and the reply will be contained in the definition.

Composition of Stellite and Stainless Steel

BY ELWOOD HAYNES,
President, Haynes Stellite Co.

This article treats of alloys of chromium with iron or cobalt, some facts about what appears to be the earliest experimentation with these alloys being given. Practical considerations concerning the constitution, manufacture, and uses of stellite and stainless steel are discussed.

THE THREE metals, iron, nickel, and cobalt, are termed by chemists the "metals of the iron group." The reason for classifying them thus is the fact that their respective properties are all quite similar.

1. They are all distinctly malleable.
2. They are all distinctly magnetic.
3. They possess high tensile strength and high modulus of elasticity.
4. When pure, they take a high polish and show a distinct metallic luster.

They also resemble one another in their chemical properties.

1. Each is readily soluble in nitric acid.
2. Each forms a monoxide with oxygen, as FeO, NiO, and CoO. Each also forms a sesquioxide, Fe_2O_3, Ni_2O_3, and Co_2O_3.
3. Aqueous solutions of their chlorides, when evaporated to dryness, are transformed into oxides.
4. Their oxides are all readily reduced by either carbon monoxide or hydrogen.
5. Their melting points coincide quite closely.
6. Their atomic weights are quite close together, that of iron being 56, and those of cobalt and nickel approximately 59.

When solutions of cobalt and nickel are mixed, it is difficult to separate the metals one from the other, owing to the fact that their behavior under most precipitants is practically the same.

In 1899, the writer produced an alloy consisting of practically pure nickel and pure chromium by heating their mixed oxides with aluminum. This alloy, when polished, retained its luster, even in the atmosphere of a chemical laboratory, and proved to be practically insoluble in nitric acid, even when boiling. It is also malleable when cold, and under proper annealing can be worked into sheets and wire.

Shortly afterward, an alloy of cobalt and chromium was produced, which not only showed the same untarnishable properties as the nickel-chrome alloy, but possessed much greater hardness. The alloy could not be worked to any extent cold, but was found to be malleable at a bright orange heat.

It was not until 1906 that the alloy was produced in sufficient quantity to determine its properties fully. In 1909, a cutting blade was made of the alloy, which took an edge comparable to that of tempered steel.

Later, tungsten or molybdenum was added, and the alloy thus produced was sufficiently hard to turn iron and steel on the lathe. Later experiments demonstrated that such alloys when properly formed, would scratch any steel, and would stand up under much higher speeds on the lathe than the best high-speed steel tools. This fact gave the cobalt-chromium-tungsten alloy termed stellite a field of its own, and placed it in a class by itself as a material for high-speed tools.

Generally speaking, the cobalt-chromium alloys possess three distinctive properties, namely:

1. They are untarnishable under all atmospheric conditions, and immune to nearly all chemical reagents.
2. They possess great hardness.
3. They retain their hardness up to visible redness.

Some of the stellite articles for ordinary use are formed from alloys of cobalt and chromium only. This alloy answers well for table knives, spoons, etc. The harder edge tools, such as pocket-knives, surgical instruments, etc., contain in addition to cobalt and chromium a certain amount of tungsten to give them greater hardness, while in other instances a certain amount of iron is introduced into the alloy to soften it so that it may be more readily worked. Such articles include table-knife blades, pocket-knife handles, certain dental instruments, etc. When iron is added to the alloy, the resulting mixture is termed "Festel metal," being made up from the chemical symbol for iron (Fe) and the first syllable of stellite.

This beautiful and easily workable alloy is well adapted to the manufacture of fine door latches, door-knobs, and high-class sanitary fittings for bath-rooms, lavatories, etc. It is not malleable except at a bright red heat, but when a certain portion of nickel is added it may be worked cold on the lathe or under the file. By suitable means, it can be given a beautiful stippled surface resembling that of frosted silver, and retains its luster in the most satisfactory manner.

Some of the later stellite alloys have shown most remarkable resistance to chemical reagents. One of these, possessing quite high chromium, takes a magnificent polish, resembling that of burnished silver. This alloy retains its luster perfectly in boiling aqua regia, and is not affected in the slightest degree after immersion in that liquid for a period of 14 days. It is slowly attacked by cold hydrochloric acid, but is practically immune to cold, strong sulphuric acid, and nearly immune to the same acid in the diluted form. It is of course strictly immune to nitric acid of all strengths.

Balance weights made of this material retain their luster under the most trying conditions. They are immune not only to the ordinary fumes of the atmosphere, such as hydrochloric acid, ammonium chloride, nitric acid, hydrogen sulphide, etc., but even to moist chlorine gas. They present a beautiful appearance, owing to their superb luster, and are so hard that their loss from ordinary wear will be perhaps unweighable for several years. There seems to be no good reason why they would not answer equally as well as the more expensive platino-iridium alloys for standard weights and measures.

In the year 1911, I made experiments on alloys of iron and chromium with a view to ascertaining definitely their properties. I quote from my notes as follows:

*Taken from paper presented before the Engineers Society of Western Pennsylvania.

November 15, 1911. While I have known for some time that chromium, when added to iron or steel, influences or modifies their properties in a marked degree, I am now engaged in gaining a definite knowledge of.

a. The effect of chromium on the resistance of steel and iron to chemical and atmospheric influences.
b. The effect of chromium on the hardness of iron and steel.
c. The effect of chromium on the elasticity of iron and steel.
d. The effect of chromium on the cutting qualities of iron and steel.

The preliminary experiments which I have already made along this line indicate that the effect of chromium on iron and steel is much the same as on cobalt and nickel.

I have prepared the following alloys:

a. Alloy 20-C. 79.4% iron, 20% chromium, 6% carbon.
b. Alloy 15-C. 84.4% iron, 15% chromium, 6% carbon.
e. Alloy 5-C. 95.0% iron, 5% chromium.
f. Alloy 10-C. 90.0% iron, 10% chromium.
g. Alloy 15-C. 85.0% iron, 15% chromium.
h. Alloy 20-C. 80.0% iron, 20% chromium.

A number of additional experiments were made during the following winter, and the following was recorded later:

April 2, 1912. A sample of chrome iron was made by melting granulated iron, 100 grams; chromium, 17 g.; ferro-titanium, 2 g. The metal fused perfectly and was very fluid. Just before pouring, about 1 g. of manganese was added. The two bars weighed 118 g. The $\frac{5}{16}$-in square bar was forged into a thin edge, which was quite hard and elastic.

April 3, 1912. Fused 100 g. iron, 17 g. chromium, 2 g. ferro-titanium, 3 g. calcium carbide, in a covered crucible same as above. The bars weighed 118 g. The $\frac{5}{16}$-in. bar was hammered into a cold chisel, which would cut iron and soft steel. It was very difficult to file. It should contain about 1 per cent carbon. It did not seem to differ much in hardness from the sample F-2. The crucible was deeply eroded inside, which was no doubt due to the lime from the calcium carbide.

Experiment H-2. Fused iron, 100 g.; chromium, 17 g.; carbon, 2 g.; ferro-titanium, 2 g.; in a covered clay crucible.

The bars were not weighed, but the metal poured clean. The $\frac{5}{16}$-in. bar was forged into a cold chisel. It seemed somewhat harder than the preceding. It forged well, but showed a very small crack at the chisel end, which was ground out before the forging was completed. The chisel showed excellent cutting qualities. It would nick ordinary stellite with but little effect on the edge.

The chisel end was heated to about 800° C., and quenched in water. This seemed to harden it to some extent and if pressed hard it would just scratch glass. It takes a fine polish but shows rather dark color. It is not acted upon by cold nitric acid, either strong or diluted, and the acid shows only slight residue when evaporated to dryness on the surface of the metal.

April 4, 1912. Eighty g. iron, 15 g. chromium, 4.5 g. molybdenum, 2 g. ferro-titanium were melted in a covered crucible. The $\frac{5}{16}$-in. bar was forged to a cold chisel edge. It would cut nails, etc., very well indeed. It seemed also to harden considerably when heated to an orange color and dipped into water. It was afterwards made into a wood chisel which took a keen edge and showed fine cutting qualities.

April 8, 1912. Two $\frac{1}{2}$ in. square by 11 in. bars were cast, one from mixture F-2, and one from mixture H-2.

Each bar was manufactured into boring bits by the Rockford Bit Works.

Two bits were obtained from each bar and one from H-2 was broken and one from F-2 was "lost" going through.

These bits were $\frac{1}{2}$ in. in diameter and about 10 in. long. Just before finishing they were annealed in lead which rendered them sufficiently soft to be filed. They were afterward reheated and allowed to cool in the air, when they became so hard that a file had but little effect upon them. They would bore wood fully as well if not better than an ordinary bit. They hold their luster in the air under all conditions.

In order to make sure that such alloys were unknown at this time, letters were written to practically all the large steel producers of the United States, asking for a non-rusting or non-tarnishing iron or steel alloy, but the replies received were all of a negative character, and showed that no such alloy existed, but suggested the possible use of alloys of nickel and iron, but in no case was chrome-iron or chrome-steel even mentioned.

The experiments recorded above distinctly show that the non-corrosive qualities of chrome-iron and chrome-steel alloys were not only discovered by the writer at the time specified, but that their physical properties were also fully demonstrated.

It is perhaps proper to state in this connection, however, that the discovery rests not on the possibility of adding to the steel other elements which may render it more or less immune to corrosion, more or less easily workable, but upon the fact that immune chrome-steels must contain more than 8 per cent chromium. For certain purposes they may contain much more than that amount, even up to 60 per cent; such steels are distinctly workable and useful, whether subjected to heat-treatment or not. Furthermore, that the proportion of carbon may be raised as high as 2 per cent without materially interfering with the untarnishable qualities of the alloy, though such alloys are, generally speaking, more easily worked if the carbon is below 1 per cent.

Numerous metals may be added to stainless or rustless steel, and some of these may contribute slight benefit, while others may be slightly detrimental. Among these are nickel, cobalt, vanadium, silicon, boron, tungsten, molybdenum, titanium, and tantalum. It is evident that an indefinite number of alloys could be thus formed, some with and some without the above elements, but none would be stainless unless it contained the proper amount of chrominum, which is the essential element to be added to nickel, cobalt, or iron to produce a stainless alloy.

Constitution and Manufacture of Stainless or Rustless Steel.

Stainless or rustless steel consists essentially of an alloy of iron and chromium, containing usually from 0.1 to 1 per cent of carbon, though the latter element may be present up to nearly 2 per cent without interfering seriously with the working qualities of the steel.

Owing to the high percentage of chromium and its tendency to oxidize at the melting point, even in the presence of carbon, it has been found advisable to melt the steel either in crucibles or in the electric furnace. After melting, the metal may be poured into ingot molds in the usual manner, and the ingots thus obtained may be forged or rolled into bars or sheets. If the ingots are of comparatively small size, they will be found to be very hard after casting, especially if they have been stripped hot and allowed to cool rather rapidly in the air. Indeed, small bars thus produced are likely to be almost file hard.

If a small piece of the steel thus produced be placed in a beaker with a piece of ordinary steel and covered with nitric acid, the ordinary carbon steel will be dissolved with great violence while the chrome-steel will remain utterly unchanged, thus proving that its immunity is primarily due to its composition. This is true whether the steel contains carbon in large or only minute quantities.

Cold chisels cast in iron or graphite ingot molds are sufficiently hard, without tempering, to cut ordinary iron or steel.

By heating cast bars to a bright orange temperature, they can be forged readily into various forms. After the forging is completed, the metal may be allowed to cool in the air, and will be found to possess remarkably fine grain and good cutting qualities.

Quenching in water enhances the hardness to a considerable degree, practicularly if the steel contains more than 0.4 per cent carbon. It is best, however, to use oil for quenching, in order to avoid local contraction stress in the finished article, which might cause it to break under slight shock or jar.

Notwithstanding the comparatively high temperature of working this steel, the bars show almost no scale during the forging operation and when finished are covered with a blue-black "skin" consisting of a thin film of oxide. Owing to the absence of deep oxidation and resistance to deformation at comparatively high temperatures, the alloy is admirably suited for casting engine valves and distilling apparatus, and for many other purposes of like nature. When ground and polished, the alloy resists tarnish to a remarkable degree. It is superior in this respect to brass, copper, and nickel plate.

Cutting Cast Iron With the Gas Torch

IN A PAPER read before the American Welding Society, April 22, 1920, Stuart Plumley and F. J. Napolitan, of the Davis-Bournonville Co., outlined some of their experiments in relation to the cutting of cast iron with a gas torch.

They said in part: "While we are rather skeptical of the commercial value of a cast-iron cutting torch, and are convinced that, financially, we shall never be repaid for the expense of our experiments, yet there are undoubtedly occasions when the cutting of cast iron would be of great value. In ordinary scrap-yard work, it is so easy to break cast iron that it would hardly be economic to use the cutting torch as for steel.

"You are all aware, of course, of that application of oxygen cutting used largely in blast furnace practice, the opening of a 'frozen' top hole. You could not quite reconcile this more or less common application of the process with the pet theory that cast iron could not be cut. One of the usual methods for releasing a frozen top hole in a blast furnace is substantially as follows: A piece of one-quarter inch iron pipe with a brass handle at least ten feet long is attached to a manifold of several oxygen cylinders. Oxygen is delivered through this pipe at a pressure of approximately 100 lb. per sq.in. A hole is started with a star drill or diamond point, until it is about three inches deep. The metal adjacent the hole is heated with a fuel oil burner or by other means. The end of the iron pipe is ignited and the composite stream of molten iron slag and oxygen caused to impinge against the frozen cast iron.

"A spectator to this performance of infernal fury, is readily convinced that the heat is not all due to the combustion of the wrought iron pipe, but that the cast iron is burning with a violence equal to that of steel. This reaction inspired some inventors to incorporate a device in an oxy-acetylene torch for cutting cast iron, which would feed a steel wire between the cutting jet and the cast-iron piece being cut. Ignition of the wire carried a stream of molten slag on to the cast iron and it was hoped thus to propagate the cut. In a second process, a plate of steel of a definite and predetermined thickness, was placed on top of the cast iron. It was hoped that the slag incidental to the oxidation of the steel would exercise some influence over the cast iron and enable it to be cut.

"Unfortunately for those responsible for the exploitation of these devices, the inventors were more concerned with converting cast iron into iron oxide by means of the oxy-acetylene torch than they were in constructing a practical process and a practical tool. It was next proposed to simplify the reaction by supplying an apparatus with a mixture of pulverized slag and iron powder, and in fact a number of patents were issued covering various applications of such a device. Crude and elementary as such devices were, they actually produced combustion of the cast iron and went a long way in stimulating us in our endeavors to find a successful method.

"Experimental work was carried on with a torch having a good many different tubes leading to the head so that almost any combination of gases at varied pressures might be obtained. Mr. Napolitan evolved from these experiments interesting theories pertaining to the reactions which take place in cutting, together with their relation to success in cutting cast iron. He has noted these theories in a separate paper. We are presenting these theories to the members of the society for what they are worth. We can actually cut cast iron and we do it by *preheating the oxygen.*"

In the paper prepared by Mr. Napolitan, he said: "From the ease with which wrought iron is cut we may conclude that an aggregate of ferrite combines with oxygen with greatest avidity, and permits the propagation of a cut with least interruption. As the carbon content is increased, there is a material change in the nature of the metal. In place of the preponderance of ferrite grains, we recognize the formation of cementite, and its union with some of the ferrite to form pearlite —the original mass of pro-eutectoid ferrite rapidly diminishing in prominence. As we should anticipate from the nature of pearlite, no material change is noticed in the performance of these alloys under the cutting torch. Of course, an ultra-precise consumption test would probably indicate a lowering of the efficiency coefficient, but from all appearances no unusual difficulty is experienced in cutting carbon steels up to about 80 to 90 point carbon. But here, a definite transition is indicated by a distinct laboring of the cutting torch. While the torch will begin a cut with practically the same effort, and proceeds to completion without interruption of unusual delay, yet the kerf is wide and ragged and undeniably distinguishable from that of a mild steel cut. It is recognized practice, now, to preheat the piece to be cut to a black or dull red heat, when the impediment, whatever it was, seems to have been entirely eliminated.

"But let metallography explain the sudden change of properties of the steel. As the carbon content of the hyper-eutectic steel was increased, the proximate mass of pearlite increased, and the pro-eutectoid ferrite correspondingly diminished in volume, until eventually a point was reached where all of the cementite and ferrite existed in the stratified or laminated relationship of pearlite. This state is recognized as existing where the carbon content is between 80 and 90 points—the approximate analysis of pearlite is yet undefined. As the carbon content is further increased, there appears a constituent that we know as pro-eutectoid cementite—in fancy, the cementite which has been ejected from the pearlite growth. It is circumstantial that the presence of this pro-eutectoid cementite is directly responsible for the increasing difficulty of our cutting. But why did preheating of the steel before cutting make such a remarkable difference in the results? To be sure, the rise in temperature might affect the stability of any martensite, troostite, or even sorbite that might have existed, but the temperature was too far removed from the $Ac_{2,1}$ point to affect the characteristics of the pearlite. And surely the pro-eutectoid cementite was unchanged—and it was this same constituent that we blamed for the difficulty.

"Again, as the carbon content is substantially increased, an equivalent interference with cutting is apparent, until, when the carbon content approaches 2.5 per cent, cutting becomes so labored as practically to cease, and no amount of preheating short of incipient fusion will permit it to propagate. As you are aware, the metal is now termed "cast iron," and a micro-

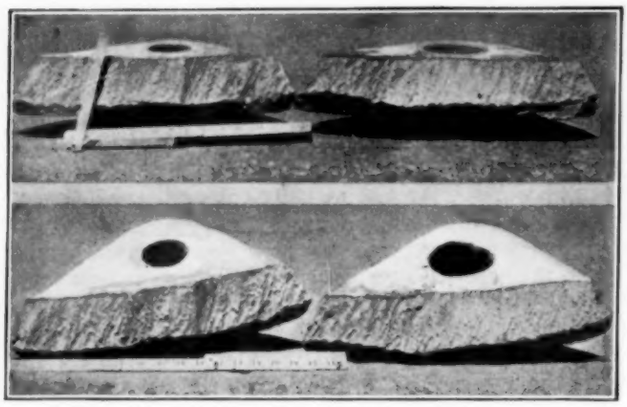


FIG. 1. FOUR CORNERS OF LARGE CAST-IRON STONE CRUSHER HEAD BEVELED WITH CUTTING TORCH FOR WELDING

analysis indicates that in addition to the presence of a certain amount of pearlite and pro-eutectoid cementite, as well as certain foreign and, to our discussion, unobtrusive substances, we recognize the presence of the final and most stable state of carbon—graphite. The pearlite constituent exercises a favorable influence upon the operation of cutting—and the pro-eutectoid cementite, while it impedes cutting, is readily compensated by a slight preheating—but the graphite presents an entirely new problem.

"We might digress from the subject enough to present some remarks that would prove the fallacy of at least one of the stereotyped explanations of why cast iron cannot be cut—that the melting point of the slag is appreciably higher than the melting point of cast iron.

A micro-analysis of the structure of an average cast iron—and by average we refer to a gray cast iron of about three to four per cent carbon—would indicate a structure identical with that of a hypothetical steel of the same carbon content, except that some of the carbon seems to have been precipitated as graphite. But should that identical pour of cast iron have been cast against a cold iron mold, or otherwise chilled, the carbon would not have been precipitated as graphite and we should have had what we shall call a "chilled cast iron," or a "white cast iron,"—and it would actually have been a hyper-eutectic steel. Such alloys are not uncommon in commerce, and the fact that operators have been able to cut them with no extraordinary effort has been responsible for innumerable false claims that cast iron has been cut. Unfortunately, the nomenclature of steels and irons is not clearly defined, and undoubtedly a chilled cast iron is but an extension of the hyper-eutectic series. The melting point of an iron-carbon alloy is a constant of its composition, whether, in the solid state, the metal exists as a typical cast iron or as a steel. Long before the point of fusion, the carbon and the iron exist in one relationship, that of austenite. The conditions affecting the pouring of a melt of cast iron would determine the final state of its constituents—and we might as readily produce a gray cast iron or a chilled white cast iron—the carbon as graphite or the carbon as in cementite. In either event, the melting points of the resulting products would be identical. We agree that chilled cast iron can be cut with comparative ease. It is evident, then, that the melting point of slag is not responsible for the difficulty encountered in cutting cast iron.

"We had concluded that while the existence of pro-eutectoid cementite appreciably retarded cutting, the presence of but a comparatively small amount of graphite completely prevented cutting. The phenomenon, if it were true, is unique, for it would pre-suppose the incombustibility of carbon. Science contradicts us immediately. In fact, our own welding practice belies us. We might point to the reaction accompanying the removal of carbon from automotive cylinders by the oxygen method—or, leaving our immediate field, we might mention the explosive combustion of carbon in ordinary gun-powder. We are forced to conclude then that, far from retarding the combustion of the steel matrix, the graphite of cast iron should actually assist it.

"We investigated further to determine how much graphite influenced cutting. We obtained specimens of so-called malleable castings of the characteristic 'black heart' structure. Such a structure is made in this country by the annealing of white cast iron in which all of the carbon exists in cementite or pearlite, the latter in some cases entirely removed. The treatment decomposes the cementite to precipitate the carbon in minute particles, differing from the graphite of gray cast iron in their extreme subdivision and uniform distribution throughout a ferrite matrix. In making a black heart casting, an oxidizing packing is used in this country so that while the core is that of a black heart casting, the mass near to the surface is ferrite. We removed this shell of ferrite so that our materials indicated, under the microscope, a uniform aggregate of ferrite and temper carbon. By preheating this piece to a dull red heat, it was cut with the characteristics of a high-carbon steel. Then we were satisfied that carbon as such did not prevent cutting, but that the physical state of that carbon was responsible. As plates of graphite, cutting was prevented; but as finely divided particles, cutting was scarcely impeded.

"Reconsidering our previous observations in the light of this development, we began to substantiate our first logical hypothesis. We found, to summarize, that ferrite permitted most readily to be cut. Pearlite with pro-eutectoid ferrite did not materially affect the conditions. A completely eutectic composition first suggested a transitory stage. The existence of pro-eutectoid cementite retarding cutting; but preheating of the piece to a red heat readjusted the conditions so that cutting was again as efficient as in the case of ferrite. As the

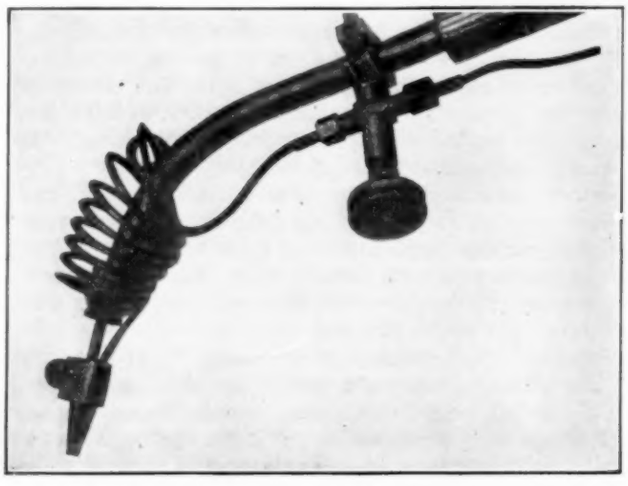


FIG. 2. CUTTING TORCH MADE TO PREHEAT THE OXYGEN CUTTING JET

comparatively low temperature produced by preheating was insufficient to effect any change in the physical state of the constituents of the alloy, we were forced to conclude that the addition of heat units affected a definite constant, which we assumed was the heat of combustion of the iron, as the two forces were of like characteristics. Then a constant result from a variable made axiomatic the existence of a second variable. Our second variable, then, we concluded, was the cooling effect of the stream of cutting oxygen, and a further thought suggested a third variable in the time of chemical reaction between the iron and oxygen. The preheating flames ignited the steel—the cutting oxygen produced combustion—and the propagation of the cut was a natural consequence. But as the carbon content was increased, the speed of the reaction was materially lowered; however, the velocity of cutting oxygen to insure a continuity of oxygen and slag to the bottom of the cut, was a constant. Then, eventually, a point was reached where the rate of combustion between the iron and oxygen was so slow that the heat units liberated from the reaction were dissipated to such an extent as no longer to ignite adjacent masses of metal—and cutting ceased. By preheating the piece before cutting, we add to the forces on the weakening side of the equilibrium, and cutting once more obtained. The heat units so obtained compensated for the relatively less heat units liberated from the chemical combination of the iron and oxygen in a definite unit of time.

"While the pearlite and pro-eutectoid cementite are readily compensated, the graphite carbon effectively prevents cutting by the ordinary means. No addition of heat units short of incipient fusion, by preheating the object, restores the equilibrium. We cannot strengthen further one side of our equilibrium, but we have not attempted to affect the other side. We have made no attempt to reduce the cooling effect of the cutting oxygen. We therefore experimented in this direction, and found that we could so effectively preheat the cutting oxygen that we could restore the equilibrium without preheating the object."

In regard to the foregoing it will be of interest to the reader to know that the following article was published in the July, 1919, issue of *Autogenous Welding*:

Substantial progress has been made which shows that cast iron cutting with the torch is a practical commercial proposition. Proof is shown in the two views of the four corners of a large stone crusher head that were prepared for welding by beveling the edges with the torch as shown in Fig. 1. The job was accepted in our welding shop, with a promise of completion in two days, but it was found that a much longer time would be required alone to bevel the edges by chipping. The staff of the Engineering and Research Department of the Davis-Bournonville Co., which had been experimenting in cast iron, was appealed to, with the result that the four pieces were made ready for welding in less than one hour!

"Each corner piece represents a cut 4½ in. thick and 17 in. long, with an area of 76 sq.in. The cuts were made in 6½ minutes each, using 24 cu.ft. of oxygen and about 4 cu.ft. of acetylene. The cut surface produced was smooth and the edges were sharply defined, as is shown in the views. The kerf was about ⅝-in. wide at the top and bottom—about the same as would be produced by cutting steel of the same thickness. The process was not one of melting, as the sharp edges prove—in fact the finish of the cut surfaces compares favorably with that of steel. After the cuts were started they were carried through to completion without a stop, and the pieces dropped apart of their own weight."

Since it is known that the cutting of cast iron is principally accomplished by preheating the oxygen, attention is called to the fact that there have been cutting torches on the foreign market for several years so made as to preheat the oxygen cutting jet. One of these is shown in Fig. 2, the principle on which it is made being self-evident.

An Aid to Determine Pulley Diameter and Speeds

BY GEORGE W. CHILDS

This letter is written in reference to the article entitled, "An Aid to Determine Pulley Diameters and Speeds," by Julius Klein in the May 20 issue of the *American Machinist*, page 1076, Vol. 52.

The writer has had considerable experience in compiling tables and is on the lookout for tables and data which will lessen the labor of designers and also be useful to shop men. I have made a careful study of the table edited by Mr. Klein and am of the opinion that it will not be of any particular benefit to shop men, and certainly not to designers. The formulas given for determining pulley sizes and speeds is published in nearly every manufacturer's catalogue of transmission machinery and in engineering handbooks; and, being the only formulas to my knowledge which can be used for the purpose mentioned, I have no hesitancy in stating that the average mechanic is perfectly familiar with its use.

Referring to the first example given in the description, I find the following: That it takes about one-half the time to get the required answer, i.e., 20-in. diameter pulley, by figuring with a pencil and paper that it does by using the table given. Computing the belt speed in feet per minute is also a very simple matter with which the average mechanic is perfectly familiar. For example, a 20-in. diameter pulley making 90 r.p.m., to find the belt speed in ft. per min. By referring to a table of circumferences we find that the circumference corresponding to a 20-in. diameter is 62.832 in., which divided by 12 is 5.236 ft. Multiplying 5.236 ft. by 90 r.p.m. we have 471.24 as the belt speed in ft. per min. Then again, we will assume that the average person interested in the subject has in his possession a table giving the decimal parts of a foot equivalent to 20 in., and if he has not this can be easily computed. Solving $\frac{20}{12}$ ft. $\times$ 3.1416 $\times$ 90 r.p.m. we get 471.24 ft. per min. for the belt speed as before.

Referring to the second example given in the descriptive matter, we are compelled to do some computing in using the table. I found that the result 1,523.16 ft. per min. on the last line in the description is an error and should read 1,623.16 ft. per min. Referring to the tenth column from the right and headed 549.8 and 21 in the table, I found in trying another combination that the fifth figure from the bottom, 87.07, is an error and should evidently be 81.07.

I should say that the table as published would not be a labor saver and the results would be hard to read. In case anyone should reproduce the table for his own use, he should by all means draw heavy lines across it, say at every fourth or fifth line of figures.

Special Methods for Making Radiators

By FRED H. COLVIN
Editor, *American Machinist*

Mechanical aids to the assembly of manufactured parts are often more difficult to obtain than machinery methods. This shows how radiators are assembled, soldered and tested rapidly and economically.

THE making of radiators for the Autocar Co.'s motors contains some interesting methods, particularly when it is remembered that the output is small as compared with that of large radiator manufacturers. The radiators are of the fin and tube type as can be seen in the illustrations. The fins are cut in the press shown in Fig. 1, this punching the 30 holes. Twenty-seven of these holes are punched through and the remaining three have points raised to act as separators between the fins. The punching, the raising of the separating points, and the cutting off of the strips are all accomplished at the one stroke of the press.

The way in which the strips are put in place on the tubes is shown in Fig. 2. Here the tubes are mounted in a bottom plate and a small cap or guide placed in the upper end of each tube. This is all done at once by means of a special plate. The platform *A* on which the bottom plate rests is adjusted to its proper position and a fin placed over the tube points or guides. The press is released, and the ram *B* forces the fin down over the tubes to the bottom position. At the same time, the platform *A* is automatically lowered by means of the spiral-grooved shaft *C*, so that the second stroke of the ram will leave the second fin in its proper position. This is repeated at each stroke until all the fins are put into place and the half-core is ready for soldering. It will be noted that the ram has a long stroke, imparted by the crank *DD*.

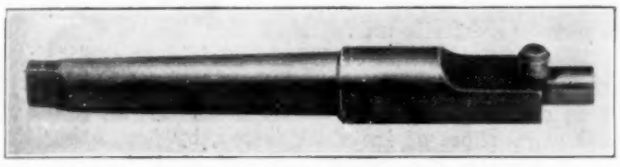


FIG. 3. TOOL FOR SPINNING TUBES

Before soldering, however, the upper ends of the

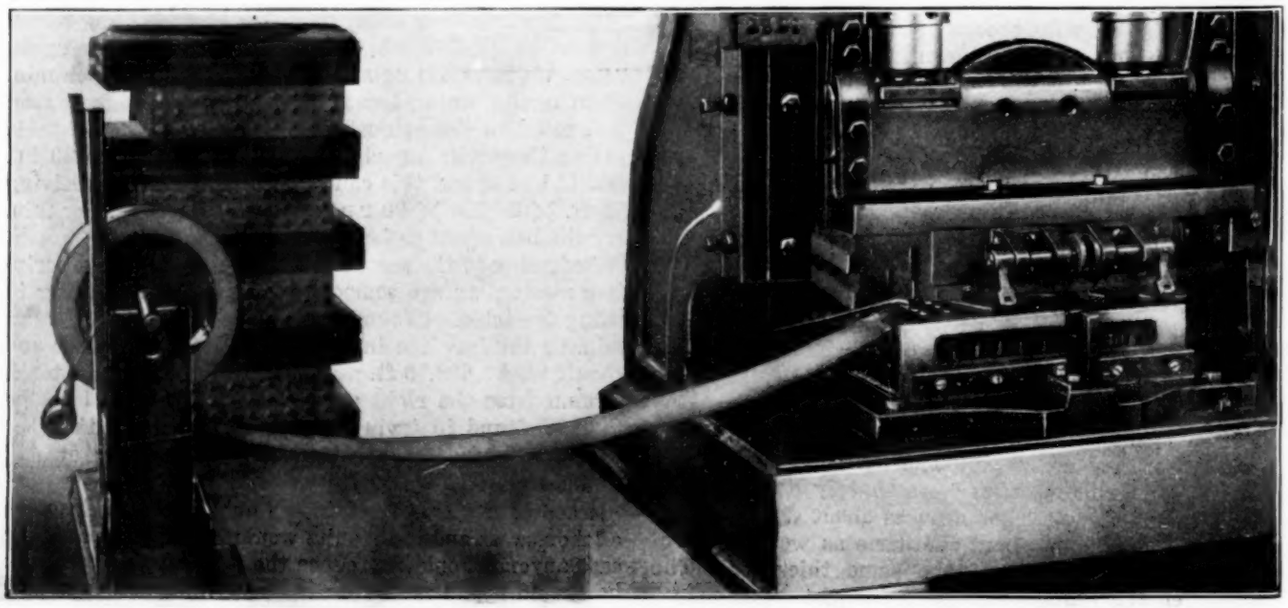


FIG. 1. PUNCHING THE FINS

AUTOMOTIVE CONSTRUCTION

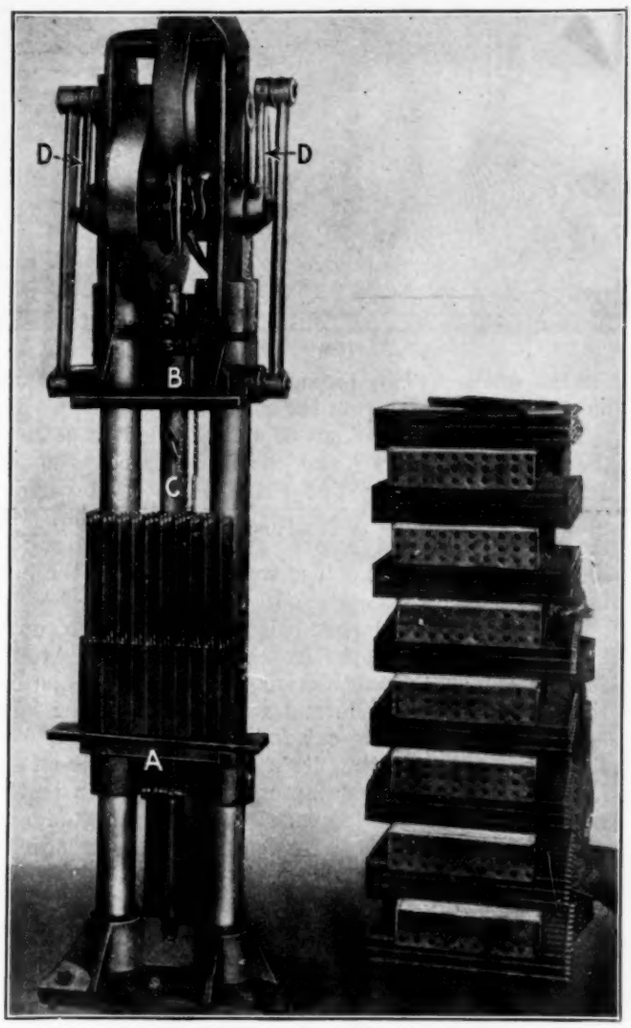


FIG. 2. ASSEMBLING FINS ON TUBES

tubes are spun into position by the tool shown in Fig. 3. This has a pilot and also a roller which beads the end of the tube to the desired amount.

The tube cores are then brought together to be soldered into position to the main tank at the top and the bottom chamber. The radiator is mounted on the wooden stand shown in Fig. 4, so as to be of a convenient height, and the shelf shown is provided for holding the soldering acids which are used for this purpose. A special gas soldering iron has been developed in a very simple manner, by which practically all of this soldering can be done without the delay of waiting for irons to be heated.

Taking Away the Soldering Fumes

The stand shown in Fig. 4 is in reality considerably more important than it looks, as it forms a connection with an exhaust system by which the fumes are drawn away from the radiator and ejected from the building by a powerful fan. This is a sort of down-draft exhaust system which has greatly increased the comfort of the men and in that way increased production and good feeling.

When the radiator has been completely soldered and attachments made, it is tested with air in the water

FIG. 4. STAND FOR SOLDERING

tank shown in Fig. 5. The main feature of this tank is the ease with which the operator can handle the radiator being tested. The radiator with all its outlets closed, except one, is laid on the rack *A* and the air hose attached to the desired opening. The operator standing at the right of the tank pushes the platform forward by the handle *B*. The platform is so mounted on the levers shown that it submerges the radiator with practically no effort on his part. Reversing this operation raises the radiator out of the water. This makes a very convenient method of radiator testing and one which can be copied to advantage for similar work.

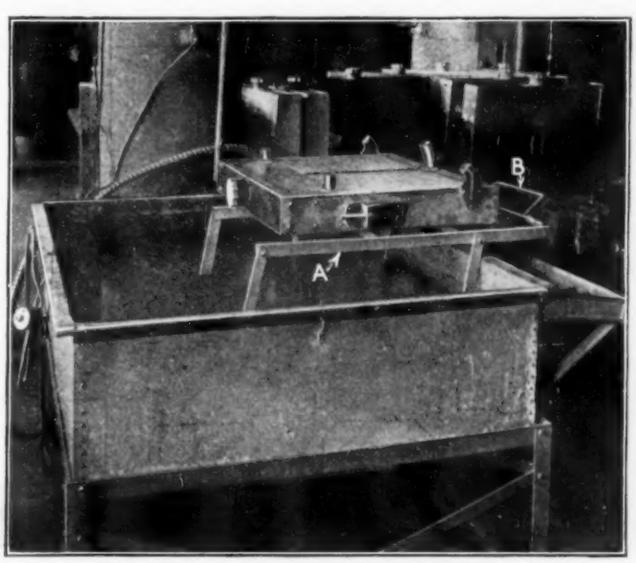


FIG. 5. TESTING FOR LEAKS

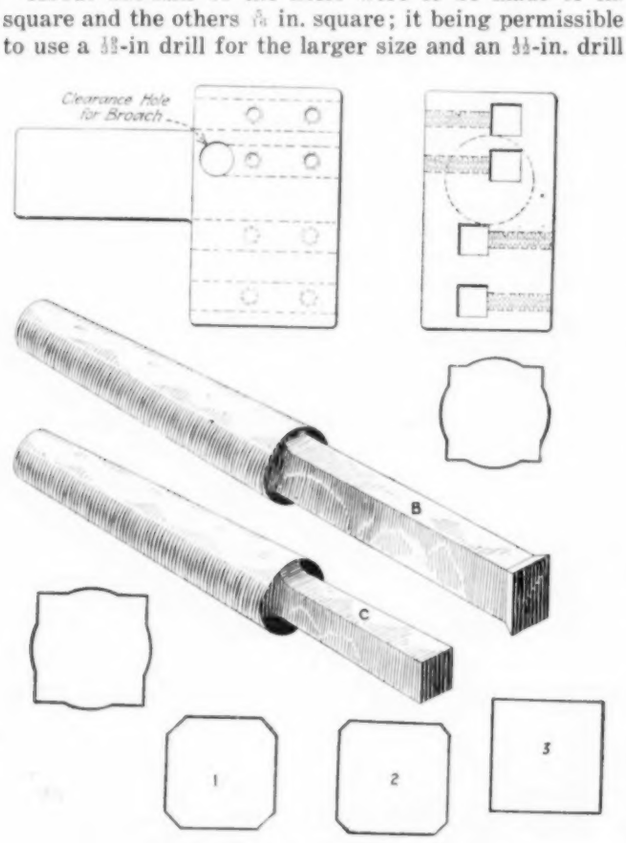
Broaching Square Holes

By John T. Clark

Recently on starting to work in a new place I was required to make some toolholders for the turret lathe, similar to the one shown in the sketch at *A*. As I was a stranger in the shop, not knowing what equipment they had, I asked the foreman what tools were available for the job, and was told that "sometimes they filed them out square; and that 'old-country' filing was pretty good"—(he was an Englishman).

Though I am from the "old country" myself, I did not relish the idea of filing the corners out of about two dozen round holes to make them square, particularly in a shop where files were neither plentiful nor in great variety, so I decided that I must find some other way to do the job.

About one-half of the holes were to be made $\frac{17}{32}$ in. square and the others $\frac{5}{8}$ in. square; it being permissible to use a $\frac{33}{64}$-in drill for the larger size and an $\frac{11}{32}$-in. drill for the smaller. This helped out a good deal as it was only necessary to take out the corners.



THE WORK AND THE TOOLS

Hand broaching was out of the question as some of the holes were "blind" and the broaches could not be driven through or back, so I decided to try broaching them in the milling machine; making broaches with taper shanks to fit the collet and using the cross-feed screw to force them in. The work was held in the milling-machine vise.

The depth of the larger holes ran from $1\frac{3}{4}$ in. up to $2\frac{5}{8}$ in. and the small ones from $\frac{7}{8}$ in. to $1\frac{1}{4}$ in. After a few experiments with different sized broaches, one like the sketch *B* was made and worked fine on the large holes. It was made to cut full size one way and $\frac{3}{4}$ in. the other way; locating it in the center of the $\frac{17}{32}$-in. holes it could be forced through without much trouble and then the table moved back and forth to make up the difference between the $\frac{3}{8}$-in. thickness and the size required by using the dials on the machine to gage the distance.

Of course, on account of the length of the broach there was considerable "spring" to the tool, but this was eliminated by giving a quarter turn to the machine spindle, thus reversing the position of the broach and forcing it through again. By repeating these tactics the hole was made quite square and smooth with sharp corners.

In the smaller holes the same method was used except that three broaches were used, two for roughing and one for finishing, and they were made as shown at *C*. It required considerable elbow grease and fetched some sweat out of me but the satisfaction of doing a good job was worth it.

Turning Hard Metal with Carborundum

By Gustave Remacle

Recently when refacing some valves, I encountered great difficulty owing to the fact that several of them were very tough and hard, and a grinding machine was not available.

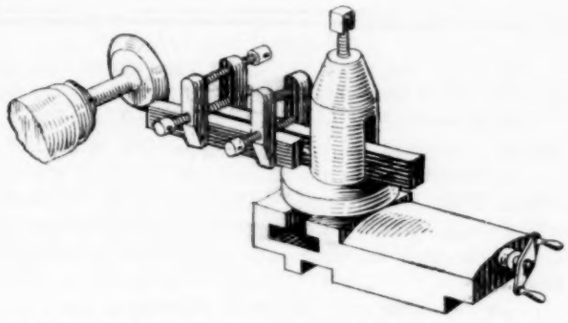
I had used steel tools which were glass hard, ground them to various shapes, and still found that I could not produce the smooth true surface which was essential.

An experienced repair man helped me out of the difficulty by suggesting the use of a piece of carborundum as a cutting tool.

I procured a piece of the carborundum that is commonly used for dressing grinding wheels and clamped it to the end of a toolholder, using two parallel clamps

and placing a piece of blotting pad between the carborundum and the toolholder in order to prevent a fracture of the stone.

I used a sharp corner of the stone when turning and during the process I found it necessary to present



TURNING HARD MATERIAL WITH CARBORUNDUM

fresh corners of the stone to the work because the stone would not hold a keen cutting edge for long.

When I saw the stone curl up a fine chip I rubbed my eyes and looked at it for several moments before I could believe it.

Stopping An Unnecessary Noise

By Martin H. Ball

While searching for unnecessary noises in and about the machine shop, and for ways to stop them, one prolific source is found that can very easily be eliminated, although it is one that is frequently overlooked. I refer to the belt-shifter guide fingers, or forks, that are used to shift the driving belt on tight and loose pulleys.

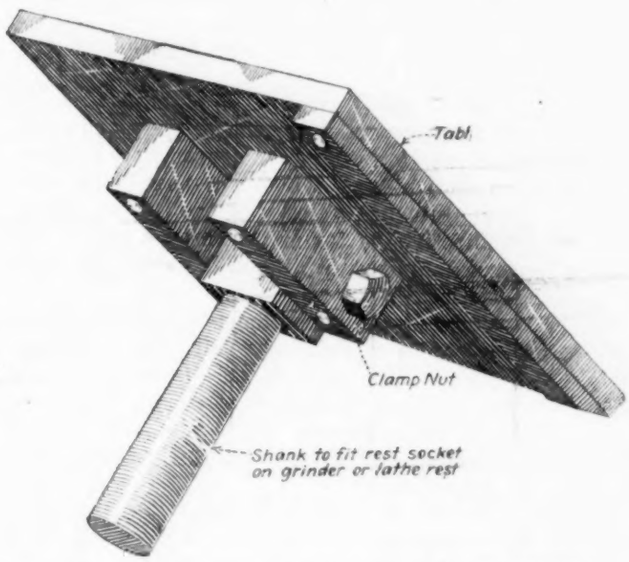
In the illustration *A* shows the noisy and wrong way and *B* the right position to secure quiet running on the same drive, while *C* shows the right way when the lower side of the belt is leading. Referring again to *A* the action is as follows: When neither finger of the pair is in actual contact with the side of the belt the fingers will tip to the left as far as their fastenings will allow, but as soon as one of the fingers is touched by the belt it will be carried to the right. As the fingers are usually placed apart slightly more than the width of the belt and because of the fact that most belts swerve sideways more or less, guiding forks so placed are almost constantly in motion and make noise in proportion to the lost motion in the sliding shaft to which they are attached, added to that in the device which connects this shaft to the shipping lever.

The cure is very simple, just place the forks at a slight inclination in the direction that gravity will hold them, and in the position that the frictional contact forces them as indicated at *B* and *C*. The angle shown in the sketches is somewhat exaggerated to make the expianation more clear. In most cases an angle of 10 deg. will give satisfactory results.

A Tilting Table for the Grinding Machine or Speed Lathe

By H. H. Parker

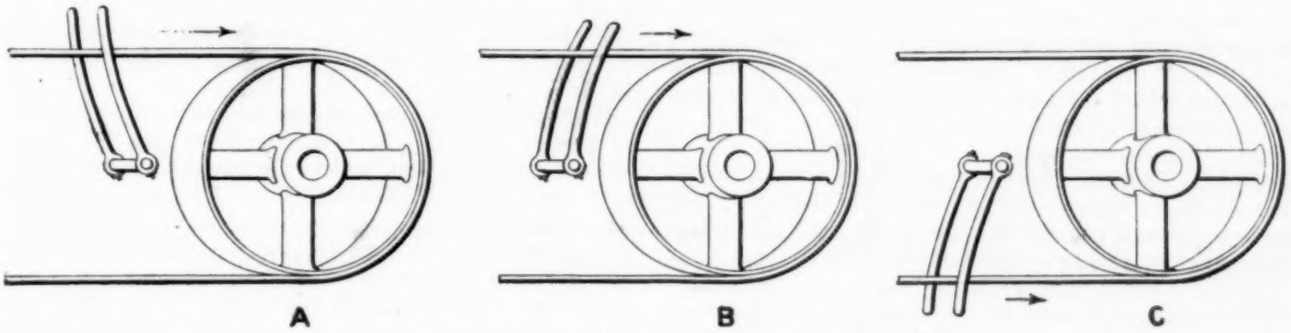
The sketch shows a small built up tilting table to be attached to a grinding stand or to a speed lathe. It may be tilted to any angle for grinding tools and other pieces of work, or if used in connection with a sandpaper disk wheel in a speed lathe chuck can be set at an angle to give draft for sanding the edges of wood patterns.



TILTING TABLE FOR SPEED LATHE OR GRINDING WHEEL STAND

As shown, the table is built up of a steel or iron plate with two pivot strips screwed to it, though if it was practicable to make a pattern and cast the table, the lugs would be cast on and a neater piece of work would result.

The lower edge of the table nearest the wheel is bevelled for clearance when tilted. A length of square cold-rolled steel will answer for the upright; the lower portion is turned down to fit the rest socket while the upper end is rounded and drilled for the clamp bolt. The square end should make a snug fit between the two table lugs.



RIGHT AND WRONG WAY TO SET BELT SHIPPER FORKS

EDITORIALS

Attention, Engineering Societies

LET us go over what we know concerning the Federated American Engineering Societies.

Its objects are "to further the public welfare—and to consider and act upon matters of common concern to the engineering and allied technical professions."

The call for an organizing conference was the outcome of a very evident need for all engineers to be represented by a single organization. The founder engineering societies, responsible, in the final analysis, for the new organization, were caused to feel such a need by a natural sequence of events extending over a period of several years.

The organization was formed at Washington, D. C., June 3 and 4, by delegates representing sixty engineering societies of the United States. There were adopted a constitution and by-laws, which are now being submitted to the engineering societies of the United States. The new organization, so far as becoming a permanent body is concerned, is dependent upon the action of these individual societies.

Several societies have taken definite action—others have acted, not quite so definitely, but very encouragingly. We publish elsewhere in this issue an article called "Progress of the Federated American Engineering Societies," which reports the action taken by a number of societies and gives other information concerning the organization.

The spirit of this editorial is to urge upon engineering societies immediate consideration and action. The metal has just been drawn from the furnace. Do the forging now. Why reheat? L. C. M.

Jumping Four Miles for a Record

LIEUTENANT WILSON of the 96th Aero Squadron has just established a world's record by making a parachute jump of nearly 20,000 feet. The recording barograph on the machine from which he made his jump showed 19,861 feet when corrected for the various errors, but a hundred feet more or less is of little moment when one is taking such a leap.

Parachute jumping has been a common "stunt" for many years, but it remained for the war to make it a practical necessity. It is barely two years since the army started experimenting with parachutes and the first tests were not any too promising. Many a sand and canvas dummy met a horrible fate as a result of the failure of its parachute to open. And now we have a successful school for parachute jumpers and to cap the climax a record jump of nearly four miles.

Can there be any doubt of the commercial future of aviation? Probably the two most serious handicaps of the new science have been its danger and its cost and now we have a proved "life-preserver" which reduces the danger to an almost negligible quantity.

At the present time all army fliers wear parachute packs whenever they go off the ground. The new pack, which is only four by ten by nineteen inches, is far less cumbersome than the early ones. In addition to this its change of location removes the serious objection on the part of the pilots that it hampered the freedom of their movements. Instead of being strapped to the pilot's back it has been transferred to that portion of his anatomy which little Johnny used to protect with a shingle on certain solemn and long-remembered occasions. Incidentally the pack in this position makes an elegant seat cushion.

The practical value of a four-mile parachute jump may not be apparent, but it is quite as real as that of the high-altitude flights of Schroeder and Rohlfs. They found high velocity wind currents of which advantage will undoubtedly be taken by the air cruisers of the future, and Lieutenant Wilson has proved the ability of the parachute to open in the thin upper air and to withstand the strain of a seventeen-minute drop through all sorts of atmospheric disturbances.

The spirit of the Wright brothers still lives in Americans, and with even half-hearted co-operation on the part of Government agencies, will bring us back to a position of supremacy in the air. K. H. C.

The Evolution of the Engine Lathe

CONSIDERABLE interest has been evinced of late as to the origin of the term "engine lathe," and various opinions and conjectures have been published in our columns.

Elsewhere in this paper appear extracts from an article by E. J. Franzen, superintendent of the Sprague Electric Works at Bloomfield, N. J., reprinted from the Sprague shop paper "The Link."

Mr. Franzen has evidently made a considerable study into the history of this indispensable tool and speaks as one having authority upon the subject. He traces the evolution of the lathe from the crude device in use hundreds of years ago, by the East Indians—and still used by them—through the period of its development, contemporaneously with the steam engine, down to the present somewhat complicated piece of precision mechanism. E. S.

Have You Ordered Your Coal?

THE question of coal may not seem as pressing as it did during the past winter. And yet we are assured that the only way to avoid the re-occurrence of the difficulty is to place our orders during the months which are usually slack and in which transportation is less difficult.

While most of us undoubtedly feel that there is more or less "bunk" in the coal operators' arguments, it behooves us to at least make an attempt to comply with their suggestions. Should this be of no avail we must look elsewhere for a remedy. But in the meantime let us see what can be done to place orders early, to buy collectively if that be possible or advantageous, to store all we can and so keep the mines busy during the summer and fall.

Under present conditions it is more a question of getting coal and of having it when we want it, than it is a question of lower prices. We pay what is demanded and have no redress in that direction. Let us get the coal orders in now. F. H. C.

The Mechanic and the Printed Page

By Marshal M. Alden

Any system that will reduce waste of material, time and effort, improve efficiency, increase production and cut down overhead, will be given an impartial trial by the fair-minded executives of any industrial or commercial establishment. And a system that will do not only all these things, but bring a greater financial return to the workers, because of their increased proficiency, will be warmly welcomed by the employees.

How and where can such a system be obtained, is a question frequently asked by executives in these days of industrial and commercial unsettlement. The answer is provided by the American Library Association, an organization of forty-four years' standing, and by the Special Libraries Association, also a national organization of high repute. According to these two cooperating Associations, the installation of special technical and business libraries in industrial and commercial establishments, while not guaranteed to produce the foregoing results, will have a direct bearing on the improved operation of the concern, its production and progress.

Under its enlarged peace-time program the A.L.A. proposes to give professional advice upon request, as to the character, scope and contents of any proposed special library. The worth of the plan could be outlined and the results forecast by experts for the benefit of the executive who considers adopting the system in his establishment. Costs would also be figured and presented with an estimate of the financial advantages which will accrue to offset the original outlay and tend to increase the gross profits.

Waste a Big Business Loss

Waste of material, time and effort is one of the great causes of industrial and business losses, often making an appreciable figure on the wrong side of the ledger. Naturally it is a factor that all executives wish to eliminate and to this end the special library is of practical and proved assistance. If the library is as comprehensive as it should be to be effective, the technical books therein will often furnish those methods of procedure in manufacture that otherwise could have been obtained only by experiments with their attendant waste of material, time and effort. While the same books are often available at the public library, the time taken to go there and obtain the information is a factor which is almost eliminated if the volumes are easily and quickly accessible in the special library within the plant.

It is quite obvious that book study of processes and machine technicalities will tend to enhance the efficiency of the worker and if the library offers the opportunity for serious reading and encourages the habit, the production results will indicate the benefits. The reading habit, once formed, is seldom dropped, it has been found, and when it is general among the forces of a factory, mill or shop, there has been a marked improvement in the amount and quality of the output. The only way to forward this habit is by having the special library at hand and showing its advantages to the employees.

"The library book taught me more about hardening, pouring and tempering steel than I learned in twenty-five years at the forge," declared an iron worker in a New Jersey factory recently. This is but one of hundreds of testimonials voluntarily given to the worth of the special library system.

Need of Books Acute

"The need of books for men in industry is more acute now than ever," declares Frank K. Walter, librarian of the special library at the General Motors Corporation. "Whether it be in agriculture, in the factory, the shop or executive office, a knowledge of the best methods of producing more goods of better quality is imperative. Only in this way can the rising level of prices be met and the high cost of living be mitigated. More than ever before, the experience of all is needed by each. Waste, whether of time, energy or material, is little short of criminal under present conditions. Vocational help through the library is not only permissible, but as necessary as many of the war activities in which the library played so prominent a part.

"Industrial corporations are realizing the need of such service and are liberally backing their own special libraries. The man who reads the technical book or the trade paper instead of resting content with what he learns from actual shop practice, is developing the initiative and individuality which have been the chief assets of American industry."

Since increased efficiency means greater and improved production at lower cost to the consumer and larger returns for the producers, both executives and employees, it follows that the means of promoting this efficiency is a valuable asset to the entire establishment and to the public. Because the special library is recognized as the means to this asset, the list of prominent concerns which are installing them is growing constantly.

The "Books for Everybody" Movement

Promotion of this system is part of the enlarged program of the American Library Association, a nation-wide movement to bring books to everybody who has limited or no access to them. The project, under the appeal, "Books for Everybody," is designed to promote the habit of reading and universal self-education through books and libraries and points to a time when the best of reading material will be within easy reach of every man, woman and child in the United States. It is a direct outgrowth of the war time service of the A. L. A. through which more than 7,000,000 books were circulated among the U. S. forces and which revealed the needs of the nation for extended library service to reach 60,000,000 persons who are inadequately served or have no means of obtaining the knowledge that is contained on the printed page.

The association's enlarged program has received the hearty endorsement of many prominent men and women in all walks of life who recognize the vast value of reading as a means of individual, industrial and business progress. To carry out the program a fund of $2,000,000 is being obtained through the individual efforts of librarians, library trustees and friends of libraries without recourse to the usual intensive campaign. It is hoped that this appeal for so worthy a cause will not go unheeded by our great American manufacturers.

WHAT to READ —for the man in a hurry

Suggested by the Managing Editor

ONCE more we are leading off with a new tool description—this time a short account of the construction and working principles of a line of duplex drilling machines built by the Moline Machinery Co. Both light and heavy machines are included in the series and between them they will account for a wide range of work capacity. An unusual special machine for sinking dies automatically appears on page 158. A product of the Keller Mechanical Engraving Co., this machine will rapidly reproduce a master die which may be of a permanent character when many pieces are to be made, or may be a wax or plaster model for experimental or special work.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

Another special machine is described on page 162. This one is designed to bore and ream automobile engine crankcases and was built to the specifications of the Bethlehem Motors Corp. by the Baush Machine Tool Co. It employs special boring bars and reamers made by the Kelly Reamer Co. and has proved satisfactory.

Frank A. Stanley, an old editor of the *American Machinist*, has an account on page 164 of the press work entering into the manufacture of a rather intricate sheet-metal chute for a coin machine. A couple of pages farther on Lucas has one of his sketch pages showing some of the things that can be made from an old drawing pencil by the ingenious draftsman with nothing better to do.

Part IX of Macready's "Elements of Gage-Making" starts on page 167 and goes into the details of the construction and utilization of fixtures for producing gages with curved outlines. It contains practical pointers from a practical man.

And now turn back for a moment to page 152 and read "Socialism-Communism." If we hadn't told you that it was printed in the June, 1878 issue of the *American Machinist* would you have guessed it? With the exception of one or two allusions to such awful things of a bygone age as r-r-r-rum and lager it reads like an outpouring of an excited modern editor against the red agitators. The machines of the present are infinitely better than those of the seventies but where human nature is concerned there seems to be nothing new under the sun. It is some consolation, after we have read some unusually pessimistic account of the dangers of Bolshevik propaganda and teachings, to remember that forty years ago our fathers were going through very much the same experience and have lived to tell the tale.

Our old friend Entropy has some hints on how to get the men to read the plant newspaper—page 150. This is good stuff. We have been in the game for some few years but we have found some excellent advice in Entropy's remarks. "The plant paper affords the very best possible chance for the management to communicate with its employees in an unofficial manner. The only danger is that some one high up in the organization may want to preach, and that is nearly the worst thing that language is used for, at least in the shop." This is equally true outside the shop, isn't it?

We remarked last week that H. H. Farquhar had gone the ten commandments six better but we seem to have understated the case. Here he is with three more, on page 151, where he finishes up his remarks on the regulation of materials.

On page 153 we reprint a paper by Chester B. Lord, which was presented at the spring meeting of the A. S. M. E. and which attracted a good deal of favorable comment. He says "threads can be produced that are interchangeable practically regardless of tolerance, that will not loosen, and are cheaper to manufacture."

Two other society papers of unusual appeal are presented on pages 171 and 173. The first is by Elwood Haynes, of the Haynes Stellite Co., and discusses the composition of stellite and stainless steel. The other was read before the American Welding Society by two of the Davis-Bournonville engineers and takes up the cutting of cast iron with a gas torch.

The latest information on the progress of the Federated American Engineering Societies appears on page 185. If you are an engineer, or expect to be one, you can't afford to miss anything that bears on this long-needed effort to unite the engineers of this country.

What Other Editors Think

Denying Fundamentals of Democracy

By Dr. Nicholas Murray Butler

In the *Valve World*

RECENTLY the startling doctrine has been taught and practiced that the strike may be used to enforce the views and wishes of a small minority of the population in matters relating not only to public transportation and to other public utilities, but to political and public acts of every sort. This is to call back the *Liberum Veto* of ancient Poland with a vengeance.

According to this doctrine a group of individuals who do not approve of the tariff levied on wool may unite to make impossible the operation of a steamer which carries a cargo of wool from Argentina to the United States, or to prevent the unloading of such cargo when the steamer reaches the docks of New York. The Government of the United States may deem it necessary to send troops and to ship munitions to Siberia, but under this doctrine stevedores and longshoremen at the ports of San Francisco and of Seattle would be entirely justified in refusing to load or to permit to be loaded the vessels which were to carry such troops and munitions in case they, as individuals should happen to disapprove of the Government's policy in this regard.

Still others might say that they would refuse to assist in operating the railways of the United States, and would unite to prevent their being operated by others, unless a certain designated public policy in regard to railway ownership and operation were quickly adopted.

It must be apparent from these illustrations that without complete loyalty to the democratic principle, without respect for law, without sincere devotion to American ideals of government, and without good-will on the part of all elements and groups of society, the economic and political life of the nation can no longer go forward, and that we are in imminent danger of national shipwreck and of incalculable disaster.

The State Is Fundamental

Were it not for the well-known irresponsibility of many of those who attempt to guide the public by teaching and by writing, it would be startling to learn that at so critical a time as this in the history of American civilization, the doctrine is actually being formally and systematically taught that man's political organization, the state, is not any more fundamental than several other forms of human association, and that, therefore, the state has no necessarily superior claim upon the loyalty and devotion of the citizen.

There are those who assert that the political state is only one among many forms of human association, and that it is not necessarily any more in harmony with what some writers are pleased to call "the end of society" than a church, or a trade union, or a Masonic lodge, or a college fraternity.

What this means when brought down from the language of academic detachment from facts to the plane of hard common-sense is that the American nation is not really a unit but a multiple object composed of men in political relationships, in church memberships, in trade union memberships, in college fraternity memberships, and in half a hundred other co-ordinate memberships, each of which has its own claims upon our loyalty.

It is held that the political relationship is but one of many, and that the individual must decide which of his relationships and which of his loyalties is at any given time to take precedence of the others.

Making Loyalty Elastic

For example, a man might decide that his loyalty to his college fraternity overrode his loyalty to the state, in so far as the latter required him to abstain from assault and battery. Or he might decide that his loyalty to his church or to his trade union required him to defy some act of Congress or some decision of the Supreme Court of the United States.

This course of reasoning and of procedure would make of life one continual lynching. Individuals or groups of individuals, would in this way be brought into constant contempt and defiance of law, with the certain result that civilization must disappear in the smoke of armed conflict between different groups of selfish and self-seeking men.

This doctrine, which it is asserted is now being taught in American universities and even in American law schools, is given several high sounding names, but it is correctly and bluntly described as the gospel of anarchy and disorder, as well as of the complete destruction of everything that mankind has accomplished during the past three thousand years.

It is because of more or less conscious adherence to this sort of teaching that the I.W.W. and other like-minded organizations propose to force political action by economic pressure or by economic war. Those who are in this state of mind not only decry but despise democracy, and those who are frank among them do not hesitate to say so.

The spokesmen for this doctrine are often persons who have never done a day's work in their lives but who, out of sheer zeal for destruction and mad passion for notoriety, associate themselves with various organizations of wage-workers and others and endeavor to bend these organizations to their own ends.

At present this doctrine is supported by an organized and apparently well-financed propaganda. We have hardly comprehended how completely the American people are at the mercy of skillful propaganda of this sort. The experience of the war taught us that propaganda can do almost anything with public opinion, at least for a time; and at this moment propaganda of all kinds is well under way all about us except as regards the one essential subject of the state's own preservation.

The state is so busy doing things for particular interests and groups that it is neglecting the protection of its own life. It would be an odd by-product of social and industrial change if state suicide were to be one of its results.

The Evolution of the Engine Lathe

(Reprinted from *The Link*)

By J. E. Franzen
Superintendent, Sprague Electric Works

The question has been asked many times, why is the machine called an engine lathe? It was so named because it came into general use, as a power-driven machine, when driven by means of a steam engine, and its development has been parallel with and linked to the development of that very useful piece of apparatus.

There is no written history of the lathe. The first machine embodying the principle, if only in a crude way, was in use in India hundreds of years ago, and lathes with the same simple construction are in use there today.

It consists of two posts driven into the ground. Through the upper end of these posts are put pins, in such a way that they point to one another like the centers on a lathe, and between these two centers or points is placed a rod hollowed out at ends to fit the centers. On this rod are placed the articles to be turned. Power is furnished by winding a cord around the rod and pulling on this cord, first one way and then the other, giving a movement to the rod, say, first right-hand and then left-hand.

The second step in the evolution was the pole lathe operated by a cord reaching from a foot treadle, around the work, and up to a pole or wooden spring fastened to the ceiling. The work rotated alternately backward and forward, and the tool was applied to the work when it rotated towards the operator.

The third step was the hand power lathe, where the power was applied to the spindle by a belt from a separate wheel stand, the wheel being turned in one direction by hand power.

All these lathes were not of much use for metal cutting as the slide rest, lead screw, and the straight bed were not invented.

It was noticed by several inventors, all the way from 1550 to 1880, that some kind of a steady feed must be provided for the cutting tool, and also some way of adjusting it was needed. Several crude lathes were invented having the primitive form of screw for feeding the tool, but there was no way of making a screw except in a very primitive way. Several attempts were made to get an adjustable rest for the tool, but very little progress was made on the making of a lead screw or a slide rest until about 1800, when Henry Maudsley, an Englishman, built a lathe that in many respects was modern in its make-up.

Maudsley's lathe, built 120 years ago, had a cast-iron bed, back rest, lead screw with 30 threads per inch, a full set of change gears, and a carriage with a simple slide rest. The lead screw was also used as feed screw for regular turning.

Mr. Maudsley's invention consisted of arranging the carriage on the lathe so its movements were controlled by the lead screw, perfecting the slide rest, and introducing the system of change gears to regulate the movement of the lead screw in reference to the spindle.

The back geared headstock was invented by Richard Roberts, born in Wales, who also invented the first successful planer.

* * *

One of the greatest, if not the greatest, inventions in our industrial life is the slide rest, invented as stated before by Henry Maudsley. Its function is to move a cutting tool in a straight line as on a lathe, parallel with the bed or at any predetermined angle to it.

This invention made it possible to make the progress that has been accomplished in all lines of mechanical pursuits; without it there would be no sewing machines, typewriters, automobiles, flying machines, battleships, or 16-in. guns, and practically all our other machine tools would be valueless.

The slide rest is called carriage when used on a lathe; cross rail on a boring mill or planer; table on a milling machine, grinder, slotter or shaper.

* * *

In about 1840 lathes were being manufactured in this country by John H. Gage in Nashua, N. H., Samuel Flagg in Worcester, Mass., and J. & S. W. Putnam in Fitchburg, Mass., and in about 1850 by Sellers in Philadelphia, Pa.

Car Detention and Car Shortage

(From *Railway Age*)

THE widespread and harmful effect of the unnecessary detention of freight cars has recently been shown by an analysis of the official reports of the Pacific Car Demurrage Bureau for the months of February and March, 1920. The figures, which are given below, refer to railroad operation in California only, but if a similar condition exists throughout the country, one of the salient reasons for the present car shortage is apparent.

During the month of February, 1920, there were 131,448 cars reported to the Bureau, an increase of 30,178 cars over the same month last year. During the month of March, 1920, there were reported 143,376 cars, an increase of 32,365 cars over the same month last year. These figures disclose the increase in the volume of business during these months.

The next and most important item in the reports is "cars-held-beyond-free-time." Considering that 48 hours, or 2 days' free time, after the first 7 a.m. after the cars are placed for industries by carriers, are allowed for unloading and loading, the following figures are vital:

During the month of February, 1920, 7,303 cars were held beyond the free time, an increase of 46 per cent over the same month the previous year, and during March, 8,866 cars were held beyond the free time, an increase of 75 per cent over the same month the previous year. The demurrage charges assessed by the Bureau for the detention of cars in February amounted to $38,637 and in March to $58,615, or a total of $97,252 for two months, equal to an annual charge of $583,512. These figures also represent a delay to equipment equal to 80,964 car days for the two months referred to.

Chairman Clark of the Interstate Commerce Commission, in a recent address to the National Industrial Traffic League and the American Railroad Association, stated that the public would have the use of 102,000 additional cars through the saving of one hour per car each day. If a saving of one hour per day for each car would increase the supply by the addition of 102,000 cars, what would be the volume of business California shippers, alone, could move if they could save the 80,964 car days now lost by reason of detention to equipment, as disclosed by the Pacific Car Demurrage Bureau's reports? It is evident that the remedy for the present car shortage is in the hands of the shipping public.

Progress of the Federated American Engineering Societies

ONE of the outstanding features of the Organizing Conference in Washington, June 3 and 4, 1920, was the enthusiastic interest and co-operation exhibited by the delegates of the local, state and regional engineering organizations. It is not surprising therefore that these organizations should be among the first to apply for membership in the Federated American Engineering Societies. In this connection it is interesting to note that the Technical Club of Dallas, at its meeting of June 22, made application for membership and at the same time filed its claim as being the first local organization to apply.

At the annual meeting of the American Institute of Chemical Engineers held in Montreal June 28 and 29, 1920, the question of the Institute's becoming a member of the Federated American Engineering Societies was favorably discussed and referred to the Council for consideration at its meeting on July 25, at which time definite action will be taken. In the discussion, the opinion was expressed that the Institute should be a member of this organization and if its finances would not permit this, that members should be assessed the necessary amount.

The Federated American Engineering Societies was organized in Washington, D. C., June 3 and 4, 1920, by delegates representing sixty engineering societies of the United States. The object of the new organization is "to further the public welfare wherever technical knowledge and engineering experience are involved and to consider and act upon matters of common concern to the engineering and allied technical professions."

The Organizing Conference entrusted the Joint Conference Committee with making provisions for putting the conclusions of the conference into effect and Engineering Council was requested to carry on this work until the new organization has been established.

To make the organization effective to the great degree planned, the various societies must ratify the constitution and by-laws which were accepted by their delegates, and apply for admission.

The accompanying article was issued by the Joint Conference Committee July 9 as a bulletin. It is a brief of the development relative to the new organization, tells which societies have taken action bearing upon it, and will serve as a reminder to those societies which have not made their decisions.

The report of the delegates to the Washington Organizing Conference was read at the meeting of the Board of Direction of the American Institute of Electrical Engineers at the Annual Convention at White Sulphur Springs, W. Va., June 30, and the following resolution adopted:

Resolved, that it is the sense of this board that the A. I. E. E. should join the Federated American Engineering Societies, but that as there is a small attendance at this meeting and a new board will be constituted commencing with the administrative year on Aug. 1, action be deferred until the August meeting of the board and that a letter be sent the members of the incoming board, with a request that they give careful consideration to the matter and be prepared to act at the next meeting.

The report of the delegates to the Washington Organizing Conference was read at the meeting of the Board of Direction of the American Institute of Mining and Metallurgical Engineers on June 25, was favorably discussed and referred to the Finance Committee to devise and report on means of meeting the financial requirements.

The report of the delegates to the Washington Conference representing the American Society of Civil Engineers will be presented at the Annual Convention of the Society, at Portland, Oregon, August 10 to 12, 1920.

In the aftermath of the Washington Conference there has been considerable discussion of the new organization and a number of incorrect statements have been made; one of these is that "During the war, technical men observed the fact that many engineering problems required the joint action of the technical societies. This requirement was met by the formation of Engineering Council. Now the Organizing Conference proposes a new organization." This is not correct, as it has been repeatedly pointed out that the work of the Federated American Engineering Societies will be administered by the American Engineering Council which will succeed the present Engineering Council. This procedure received the approval of Engineering Council at its meeting on Oct. 16, 1919, when it indorsed the "General plan for national engineering council which previously had been outlined by the Joint Conference Committee of the Founder Societies."

It has also been suggested in the technical press that "no specific business is as yet outlined for action by the Council" and that "the federated society is so completely nebulous that one cannot commend or condemn it, and it will be some time before the new organization will begin to function." As a matter of fact the Organizing Conference at the closing session on June 3 adopted the following resolution:

Resolved, That it is the sense of this Organizing Conference that the Joint Conference Committee should be entrusted with making provisions for putting the conclusions of this conference into effect and that Engineering Council be requested to carry on its work until the new organization has been established, and by all proper means to further the program of the new organization. The conference further recommends to the contributing societies that they continue supplying the funds required by Engineering Council until its work is taken over by the new organization.

Engineering Council at its meeting of June 17, 1920, unanimously adopted the following resolutions:

Voted, That Engineering Council heartily endorse the plan of organization of the Federated American Engineering Societies and the American Engineering Council, adopted by the Organizing Conference of technical societies in Washington, June 3 and 4, 1920, and authorize its Executive Committee to proffer and perform on the part of the council such assistance as may be practicable in completing the

work of the Organizing Conference and of the Joint Conference Committee of the Founder Societies in establishing the American Engineering Council.

Voted, That Engineering Council authorize its Executive Committee to deal with any question of co-operation with the Joint Conference Committee of the Founder Societies, relating to the permanent organization of the Federated American Engineering Societies, which may come up during the summer.

Voted, That the secretary be instructed to invite future meetings of Engineering Council delegates of the societies participating in the Organizing Conference in Washington June 3 and 4, and editors of technical journals who may be interested.

The action of Engineering Council in accepting the invitation of the Organizing Conference means that the activities of Engineering Council, which are those to be undertaken by the Federated American Engineering Societies, will be continued without interruption until the American Engineering Council is prepared to take up the work.

The statement that the new organization "is completely nebulous" is refuted by the fact that the Organizing Conference in Washington adopted a complete constitution and by-laws to govern the organization which came into active existence when the American Society of Mechanical Engineers applied for membership immediately following their adoption, and at which time assurances were given that the Detroit Engineering Society and the American Institute of Electrical Engineers had taken, or would take, similar action.

To this nucleus must be added the Technical Club of Dallas, so that the Federated American Engineering Societies has come into active existence and the first meeting of its governing body will be held probably in November of this year.

There seems also to be doubt as to the purpose of the new organization as set forth in the Constitution:

The object of this organization shall be to further the public welfare wherever technical knowledge and engineering experience are involved and to consider and act upon matters of common concern to the engineering and allied technical professions.

The organization is to deal with what are commonly known as welfare or non-technical matters. It is not a social organization; it is not an organization of individual members. As its title indicates, it is a federation of societies with whose autonomy and activities it in no way interferes. It does not create a new technical society but it will succeed the present Engineering Council and will be more comprehensive as to scope and membership.

The Federated American Engineering Societies will not in any sense be a competitor of any existing organization. Its success will depend upon the whole hearted support given by the individual engineers and allied technologists of this country through the respective engineering and allied technical societies with which they are identified. The unanimity of opinion in which there was no dissenting vote, with which the following fundamental resolutions of the Washington Organizing Conference were adopted indicated that the psychological moment had arrived for an organization of this character and this fact assures its success:

Resolved, That it is the sense of this Organizing Conference that an organization be created to further the public welfare wherever technical knowledge and engineering experience are involved and to consider and act upon matters of common interest to the engineering and allied technical professions.

Resolved, That it is the sense of this conference that the proposed organization should be an organization of societies or affiliations and not of individuals.

Proposed Code of Ethics for the American Society of Mechanical Engineers

A proposed code of ethics was submitted at the spring meeting of the American Society of Mechanical Engineers by the committee, which was appointed in October 1919. It was suggested by the committee that the code adopted in 1912 is too lengthy; that a new code should be common to engineers of every branch of the profession and to architects; and that Engineering Council, or a similar joint professional body, be requested to appoint a committee from all the technical societies to prepare the new code.

The tentative code published herewith was offered for use as a code if the joint committee is not appointed and as a basis for its deliberation if the suggestion of forming such a committee is put into effect.

Proposed Code of Ethics

1. The mechanical engineer should be guided in all his relations by the highest principles of honor, of fidelity to his client, and of loyalty to his country.

2. His first duty is to serve the public with his specialized skill. In promoting the welfare of society as a whole he advances his own best interests, as well as those of the whole engineering profession.

3. He should consider the protection of his client's or employer's interests in professional matters his essential obligation, provided these interests do not conflict with the public welfare.

4. He shall refrain from associating himself or continuing to be associated with any enterprise of questionable or illegitimate character.

5. He can honorably accept compensation, financial or otherwise, from only one interested party unless all parties have agreed to his recompense from other interested parties.

6. He must inform his clients of any business connections, interests or circumstances, such as might influence his judgment or the quality of his services to his clients.

7. He must not receive, directly or indirectly, any royalty, gratuity or commission on any patented article or process used in the work upon which he is retained without the consent of his clients or employers.

8. He should satisfy himself before taking over the work of another consulting engineer that good and sufficient reasons exist for making the change.

9. He must base all reports and expert testimony on facts or upon theories founded only on sound engineering principles and experience.

10. He must not regard as his own any information which is not common knowledge or public property, but which he obtained confidentially from a client or while engaged as an employee. He is, however, justified in using such data or information in his own private practice as forming part of his professional experience.

11. He should do everything in his power to prevent sensational, exaggerated or unwarranted statements about engineering work being made through the public press. First descriptions of new inventions, processes, etc., for publication should be furnished only to the engineering societies or to the technical press.

12. He should not advertise in an undignified, sensational or misleading manner, or offer commissions for professional work, or otherwise improperly solicit it.

13. He should not compete knowingly with a fellow-engineer for employment on the basis of professional charges or attempt to supplant a fellow-engineer after definite steps have been taken toward the other's employment.

14. He should assist all his fellow-engineers by exchange of general information and valuable experience or by instruction through the engineering societies, the schools of applied science, and the technical press.

SHOP EQUIPMENT NEWS

– Edited By –
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

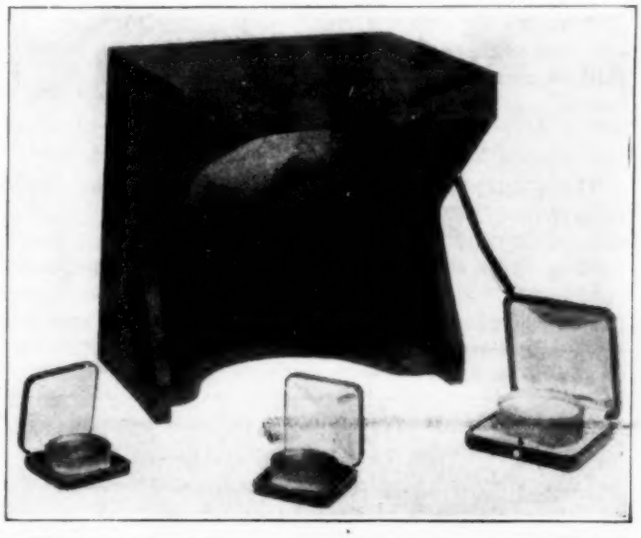
• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

Van Keuren Optical Equipment for Comparison of Standards

The Van Keuren Co., 1706 Commonwealth Ave., Boston, Mass., is placing on the market an optical equipment for inspecting flat surfaces and comparing the length of one standard with another by the interference of light waves. The equipment, illustrated herewith, comprises two working optical flats, one master flat and one source of monochromatic light. Comparisons can be made in units of one-half wave length of light, which for daylight is approximately 0.00001 in. As it is easy to estimate with the eye one-tenth of the width of an interference band, the difference of 0.000001 in. may be seen. The equipment is accompanied by full directions for its use.

Any one of the three optical flats may be used for flatness tests, though only two are required for comparison of length. However, all the flats have one accurate surface and can be used to test each other by the method ordinarily used in originating surface plates. It is claimed that the accuracy of the working flats is within 0.000005 in. and that of the master flat is within 0.0000025 in.

The monochromatic light apparatus consists of an oak box containing a tungsten-filament lamp and a selenium diffusing glass which transmits only a light of definite wave length giving 8 interference bands in 0.0001 in. or 0.0000125 in. per band. The light is simple, requires no transformers or resistances and can be operated by either a.c. or d.c. current from a lamp socket. The whole equipment is intended for shop use.



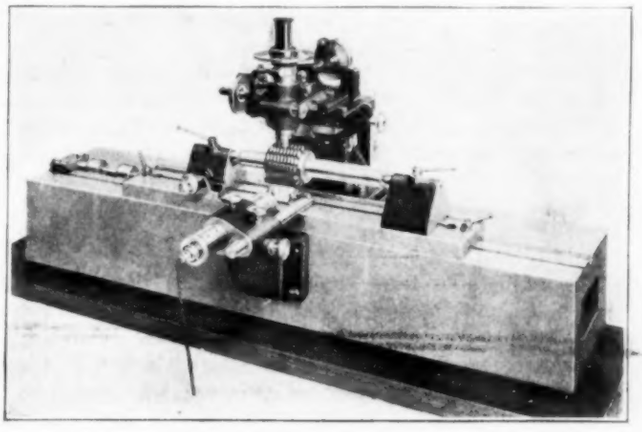
VAN KEUREN OPTICAL EQUIPMENT FOR COMPARISONS OF STANDARDS

Herbert Microscopic Measuring Machine

The measuring machine illustrated herewith has lately been placed on the market by Alfred Herbert, Ltd., Coventry, England with branch offices at 54 Dey St., New York City.

The machine has a rigid box bed, carrying a table capable of 12-in. longitudinal movement by accurate amounts by insertion and removal of hardened steel measuring rods between flat contact pieces. The table carries a pair of centers, one of which can be adjusted crosswise to enable accurate alignment of work. A microscope fitted with two crosshairs, one rotating with the outside tube and the other rotating with the eyepiece, is mounted on a compound slide controlled by micrometer screws. The outer tube of the microscope has a dial reading to half degrees and the eyepiece has a vernier reading to one minute of arc. Thus the angle shown by the crosshairs can be accurately determined.

A light projector is fixed to the machine and will project parallel rays of light through a lens upon a mirror and past the work. When measuring threads this attachment eliminates the shadows and light projected from the flanks of the thread which tend to render the object indistinct. Accumulators of 8-volt capacity are required for the projector but are not included in the regular equipment.



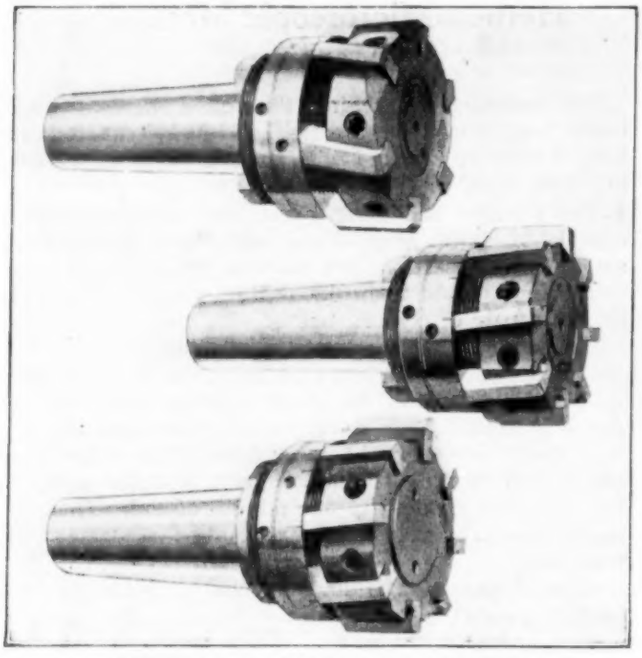
HERBERT MICROSCOPIC MEASURING MACHINE

Wetmore Cylinder-Reaming Sets

A set of special tools for reaming cylinders is being placed on the market by the Wetmore Reamer Co., Milwaukee, Wis. The tools, as shown in the illustration herewith, are designed to produce round, straight and thoroughly smooth holes and the maker recommends the use of the complete set to insure getting this result. The reamers are made in sets of three consisting of a roughing reamer, semi-finishing reamer, and finishing reamer. They are furnished with arbors to fit all makes of machines.

The roughing reamer, which is the top reamer shown in the illustration, is designed to stand the work of the initial reaming operation. The blades are set at a right-hand cutting angle and are held in place by a head lock-nut and jam-nut of heat treated alloy-steel.

The semi-finishing reamer, in the center of the illustration, has blades with a left-hand cutting angle. The



WETMORE CYLINDER-REAMING SETS

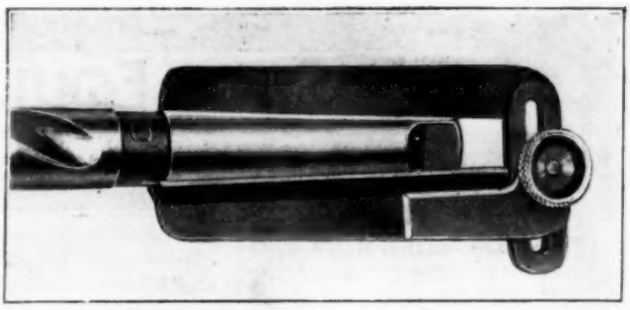
blades can be adjusted by a graduated micrometer lock-nut at the rear, which allows for adjustment of 0.001 in.

The bottom reamer shown in the illustration is the finishing reamer which is of the floating or float-in-head design, with blades set at a left-hand cutting angle, and unequally spaced. The floating device is an improved Oldham float having rollers, thus minimizing friction, and is thoroughly protected from dust and grit. All cutting blades are made of high-speed steel and adjustments may be made to 0.001 in. by means of a graduated nut.

Knauel Adjustable Taper Gage

The adjustable taper gage illustrated herewith has been placed on the market by the Knauel Tool Works, 1544 Twenty-four and One-half St., Rock Island, Ill. This device can be quickly adjusted and locked in position on any taper for duplicating work.

In use, the piece to be duplicated is laid in the lower V and the top piece brought down until light is excluded. The gage is then locked in position. The gage is made

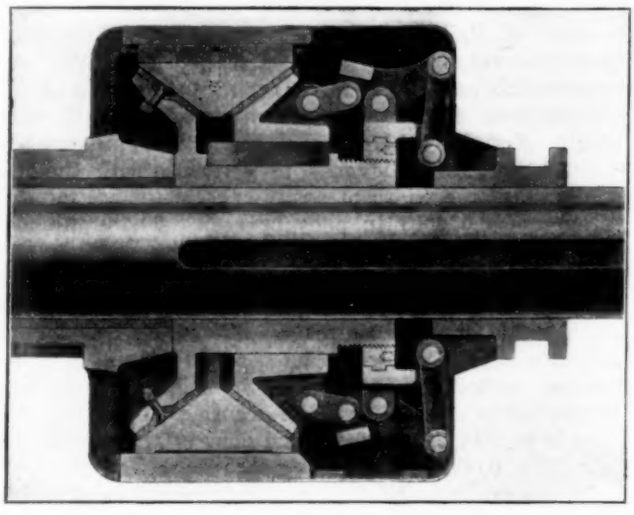


KNAUEL ADJUSTABLE TAPER GAGE

in only one size and will cover the ordinary range of tapers up to No. 11 Brown and Sharpe or No. 4 Morse.

Link-Belt "Twyncone" Friction Clutch

The "Twyncone" friction clutch, shown in the illustration, is a recent production of the Link-Belt Co., Chicago, Ill. This clutch embodies the following fea-



"TWYNCONE" FRICTION CLUTCH

tures: One-point adjustment; perfect balance; and complete inclosure of all moving parts.

Very high speed may be attained without causing "throw-in" or "throw out," and the clutch can be engaged or disengaged when running at any speed. The friction cones are lined with thermoid.

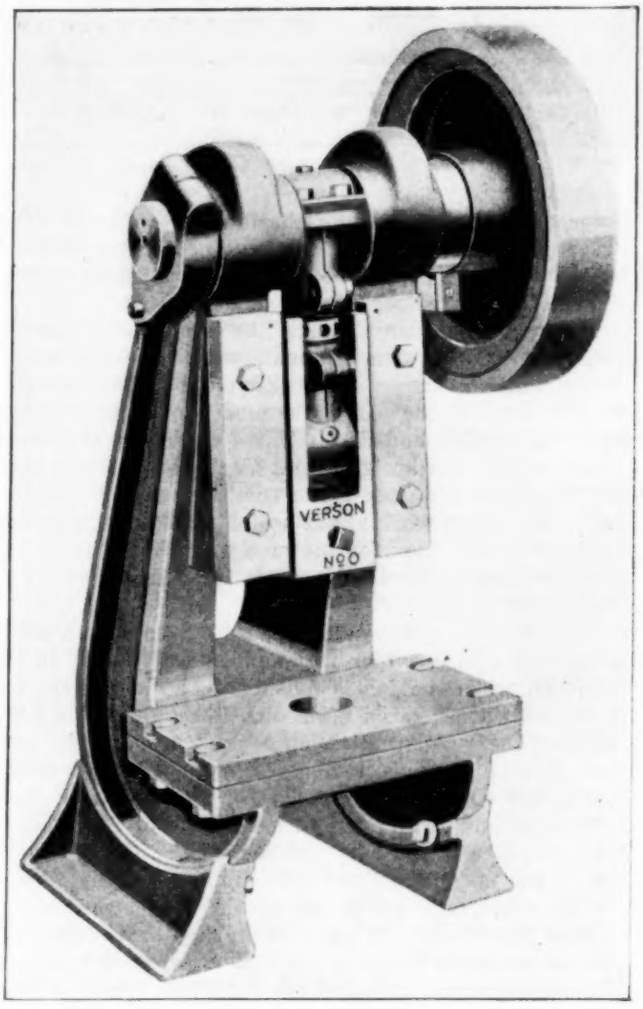
Ettco Insert Center

The Eastern Tube and Tool Co., 594 Johnson Ave., Brooklyn, N. Y., has introduced a line of machine centers of the type shown. The threaded points are made of high-speed steel ground to size and are interchangeable. The shanks are made of carbon steel, hardened and ground, and are furnished in all standard sizes and tapers.

ETTCO INSERT CENTER

The Verson No. 0 Inclinable Power Bench-Press

The illustration shows the No. 0 size inclinable type power bench-press, built by the La Salle Machine Works, 3013 South La Salle St., Chicago, Ill. The maker claims that this machine is adapted for the use of such manufacturers as jewelers, electrical brass workers and adding machine and novelty work, on small parts where speed and accuracy are required.



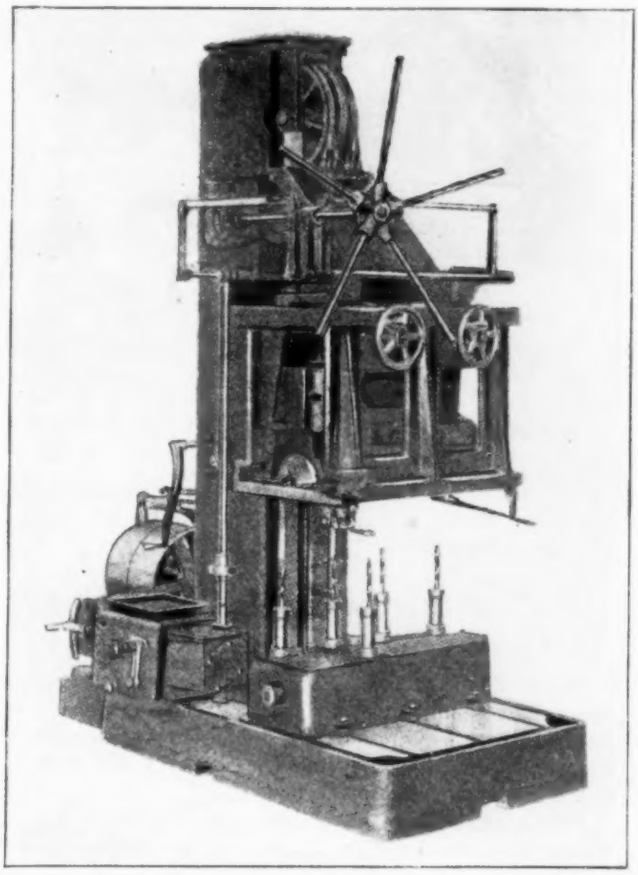
VERSON NO. 0 INCLINABLE POWER BENCH-PRESS

Specifications: Stroke, 1 in. Adjustment of slide, 1 in. Bed to slide, with stroke down and adjustment up, 5 in. Area top of bolster, 6 x 8 in. Thickness of bolster, ¾ in. Width of opening through back, 4 in. Height, bench to center of shaft, 21 in. Flywheel, 12 in. diameter, by 2¼ in. face; speed, 225 r.p.m. Hole in bed, 3 x 3½ in.

It is provided with a hardened tool steel clutch with the addition of an automatic safety device which disengages at each revolution of the press, even without the release of the treadle. This automatic safety device can be disengaged when the machine is to be used for repeating strokes. The machine is of the open-back type and can be furnished with a table and legs if desired.

Natco No. 85 Inverted Drilling Machine

The drilling machine shown is a product of the National Automatic Tool Co., Richmond, Ind. It is used to advantage for deep hole drilling in cast iron as there is no accumulation of chips in the holes to interfere with the drill so that it is not necessary to back out the drills at frequent intervals to remove the chips. The machine as shown is arranged to drill five ⅝-in. holes at one time to a depth of 4¾ in. The work is held in a special fixture supported from the table which feeds downward. When placed in position the work is securely locked by means of two handwheels. The drill spindles are adjustable for position and the bearings are amply protected against dust and chips.



NATCO NO. 85 INVERTED DRILLING MACHINE

Baird "Yoke" Riveter

We regret to state that an error occurred in our description of the Baird Pneumatic Tool Co.'s yoke riveter in our issue of July 8, page 89. Through a typographical error the word "yoke" appeared as "type" and we hasten to make the correction.

Lafayette Button Die Grinding-Attachment

The Portable Universal Grinding Machine manufactured by the Lafayette Tool and Equipment Co., 21 South 12 St., Philadelphia, Pa., and described in volume 51, No. 20 of the *American Machinist* is now equipped with a button die grinding-attachment as shown. The attachment comprises an index plate, a set of nine die holders, a graduated adjustable feeding device for the rack work holder, chucks and abrasive pencils. The die holders will accommodate A. S. M. E. Standard and fractional dies, and the index plate is drilled for both three- and four-grooved dies. The work, while held

LAFAYETTE GRINDING MACHINE WITH BUTTON DIE ATTACHMENT

rigidly in the die holder, is controlled by the index plate which can be set to suit the various widths of flutes in the dies to be ground.

A Cost System for the Small Shop

By H. L. WHEELER

The problem of cost keeping is very often a vexing one to the small shop proprietor. The elaborate and intricate cost systems of the big shops are far too expensive to operate, and efficiency experts and systematizers are out of the question.

The system here described was designed by the writer and has been in successful use for more than two years in a shop building special automatic machinery and doing a great variety of repair work. This shop employs, on an average, twenty-five men. Two different types of machines are built and they are generally ordered in lots of four. One machine has about 450 parts and the other has about 600 parts. A good set of drawings is available for each machine, each part being show on a separate sheet 9 x 12 in. in size.

When an order for four machines is received the superintendent issues a shop order on the form shown in Fig. 1. This form is simple and merely serves as an

DUPLICATE
MACHINE SHOP ORDER

No. 370 July 7 1919

Manufacture four (4) K-type folding machines complete.

Order completed ..... By Supt.

FIG. 1. SHOP ORDER WHICH IS MADE OUT IN TRIPLICATE

JOB NO.		CHARGE
1382	MACHINE SHOP	370

MFGR. 28 - Toggle bolts - turn, thread & fit pivots - finished

DRG K-210 DATE 4-2-1919

NAME A. Martin NO. 403 TOTAL TIME 25 hrs

FIG. 2. JOB CARD MADE OUT BY FOREMAN

order to the foreman to go ahead with the work. The order is made out in triplicate and one copy is retained by the superintendent, one goes to the office cost division, and the third goes to the shop foreman.

To start an order through the shop the following steps are taken: The foreman writes the job cards, one of which is shown in Fig. 2, giving a brief description or name of the part to be made, together with the drawing number and date. These cards are numbered consecutively and are filed in a small box which is kept on the foreman's desk. One compartment of this box serves for filing work ahead as just explained, a second contains a tab index for the men with their names and numbers, and a third holds cards for odd jobs and outside repair work.

The time card shown in Fig. 3 is given to the workman with each new job and handed back again to the foreman when the job is finished. The men make out their own time cards each day, these being checked against the regular attendance clock cards. The card will serve for one week if necessary, and each week all cards are collected and cards for the following week are given out to the men with the date of Saturday of the new week appearing thereon. The time card also bears the shop order and job number, making it easy to assemble very quickly all of the time spent on any job or shop order. When jobs or shop orders are completed the cards for each are filed in separate boxes for future reference, and they are most valuable in making estimates on new work or similar repair jobs, as the case may be.

While this system may not be scientific or accurate to decimals of an hour, it has given excellent results. It is operated at small expense, as the foreman can handle the whole system without the aid of a clerk.

S. O. 370 Job No. 1382 Week Ending AUG 1 41919

NAME A. Martin No. 403 Man's Rate 55¢ Shop Rate

	Lathe	Drill	Shaper	Planer	Bench	Floor	Repair	REMARKS
S								
M								
T	7							
W	9							
T	9							
F								
S								

TOTAL LABOR 25 hrs SHOP EX. MAT. TOTAL COST

FIG. 3. TIME CARD USED BY WORKMAN

A Horsepower and Torque Chart

By John S. Watts

The chart shown herewith will prove useful in determining the sizes of gears or pulleys required to transmit a given horsepower at a speed given in revolutions per minute.

To determine the pitch and face of the teeth of a gear that will transmit the required horsepower, it is necessary to convert the horsepower into its equivalent in pounds of pressure at the pitch line of the gear. This pressure at the pitch line is dependent upon the diameter of the pitch circle, and as both are unknown quantities it is necessary to assume one or the other to solve the equation.

To use the chart, draw a horizontal line to the left from the intersection of the vertical line marked for the revolution with the diagonal line for the diameter chosen. From the point where this horizontal line cuts the vertical line marked 3,300, draw a diagonal line to the zero point at the left, and at the point where this diagonal line intersects the horizontal line for the required horsepower, we read the pressure that will be exerted by that horsepower, at the diameter and revolutions given.

For example, to determine the pressure on the teeth of a gear to transmit 40 hp. at 50 r.p.m. As already shown, it is necessary to assume a diameter for the gear which we will take as 60 in. From the intersection of the 60-in. diagonal line, and the 50-r.p.m. vertical line, we draw a horizontal line (shown dotted on the chart) to the 3,300 vertical line.

From this last point, we draw a diagonal line towards the zero point at the left, and where this diagonal crosses the 40-hp. line, we read the pressure to be 1,680 pounds.

As the gear formula alters the stress allowed on the teeth of the gear with different velocities, it is necessary to know the peripheral velocity at the pitch line and therefore this velocity has been given at the right-hand side of the chart. In the example used above, the 60-in. gear at 50 r.p.m. has a peripheral velocity of 785 ft. per minute.

The formula upon which this chart is based is

$$\text{Hp.} = \frac{\text{pressure on teeth} \times \text{peripheral velocity}}{33{,}000}$$

$$\text{and } \therefore \text{ hp.} = \frac{\text{pressure} \times \pi \times \frac{\text{diameter}}{12} \times \text{r.p.m.}}{33{,}000}$$

As the horsepower in the above formula varies directly with each of the quantities on the other side of the equation, it follows that the chart can be used for revolutions, diameters or pressures beyond its range, by simply dividing that quantity, which is too high, by ten (or any other suitable amount), and multiplying the answer given by the chart by ten or whatever figure was used.

For example, a 6-in. pulley at 500 r.p.m. will have the same peripheral velocity and will transmit the same horsepower with the same pressure as a 60-in. pulley will at 50 r.p.m.

The chart is used in precisely the same way for belt pulleys and rope pulleys, the pressure given then becomes the effective pull on the belt or rope.

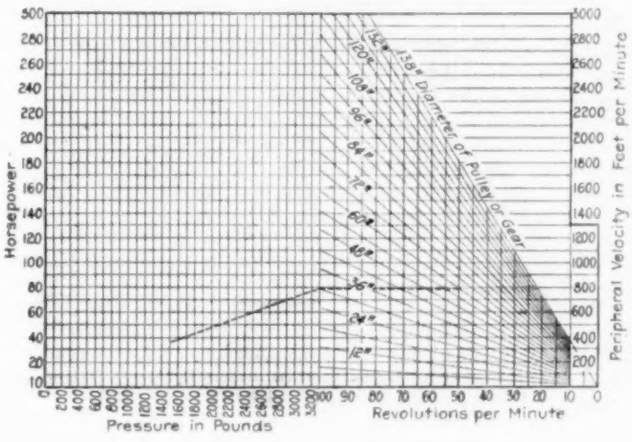
The following description of the method used in laying out this chart will serve as proof of its accuracy:

First we lay off the vertical line, marked 3,300, and divide it with horizontal lines to represent to scale the peripheral velocity up to 3,000 ft. per minute, each division representing 100 ft. to scale.

On this vertical line mark points to represent the peripheral velocity of each diameter of gear up to 138 in. at 6-in. intervals, calculated for a speed of 100 r.p.m. to the same scale and join each point by diagonal lines to the zero point at the right.

Now divide the base line of the triangle to represent up to 100 r.p.m. and erect perpendiculars at the points representing increments of 5 r.p.m.

It follows from the law of similar triangles that as the heights on the 3,300 line are the peripheral velocities for the respective diameters at 100 r.p.m., the height of any intersection of any diameter diagonal with any revolution vertical line, is the peripheral velocity of that diameter at that number of revolutions per minute, to the same scale.



HORSEPOWER AND TORQUE CHART

$$\text{As the horsepower} = \frac{\text{peripheral velocity} \times \text{pressure}}{33{,}000}$$

it follows that the horsepower at a pressure of

$$3{,}300 \text{ lb. will be} = \frac{\text{peripheral velocity} \times 3{,}300}{33{,}000} = \frac{\text{peripheral velocity}}{10},$$

Therefore, the horsepowers are marked at the left-hand side of the chart at one-tenth of the corresponding peripheral velocities.

The base line at the left is now divided up to represent 3,300 lb., and verticals raised at each 100 lb. division.

It can be seen that if a diagonal line be drawn from any point in the 3,300 line to the zero point at the left, the height of any vertical line to this diagonal line will be equal to the horsepower at the pressure represented by the vertical line, at the peripheral velocity represented by the height of the point taken on the 3,300 line. This because the height to the aforesaid part on the 3,300 line is equal to the horsepower at a pressure of 3,300 lb. at the peripheral velocity corresponding to the height at that point; and the heights of the vertical lines to the diagonal line, are necessarily proportional to the pressures marked at the respective vertical lines.

Business Conditions In England

FROM OUR LONDON CORRESPONDENT

London, June 18, 1920.

WHILE orders already received will carry on most members of the machine-tool industry for a period that can be measured in months, it seems to be undeniable that inquiries and orders of late have been much less numerous. The decline was noticed four or five weeks ago and has steadily become more marked. That it is fairly general is evident from the fact that the writer has elicited the same report by personal inquiries in four machine-tool localities in the West Riding of Yorkshire and reports from Birmingham, which mention in some cases almost hand-to-mouth working (the latter being exceptional). The holiday period setting in, fears of war-wealth or capital levies, and of dearer money, with restrictions of credit by the banks, have been causes. Then, too, doubt as to the effect of new taxation has certainly implied hesitation in enterprise.

R. McKENNA'S TAXATION FIGURES

It will be recalled that the excess profits duty was, according to all anticipation, to be removed entirely this year. Indeed, as herald of the storm rising against the financial policy and methods of our government of business men—and others—R. McKenna (the minister who as the then Chancellor of the Exchequer was responsible for the introduction of this duty during the war and who is now out of politics but engaged in banking) definitely stated only a day or so ago that "in framing it he had no conception of its continuing beyond the period of the war." He frankly pledged himself, he believed in the full confidence of his then colleagues, "that the tax should not be continued in peace." In his view the nation cannot afford to pay more than £1,000,000,000 a year in taxation. Yet, on the present basis of taxation, the revenue is estimated at £1,116,000,000, but some of the taxes are not productive for the whole year, and in a full year the revenue estimated is £1,238,000,000.

The McKenna figures need support. If they are correct it is clear that Great Britain is attempting taxation on too heavy a scale. But there is another view more prevalent as to decline; namely, that prices have reached a point at which the buyer must consider twice. Not that at present prices of machine tools tend toward reduction. On the contrary, increases have been imposed of late, on account of both the rising wages and the higher costs of castings and materials generally. Japan and India may be mentioned as good customers of late.

THE MOTOR INDUSTRY

The motor industry now shows little in the way of expansion of productive facilities. The cycle trade, too, has not come up to expectations, probably on account of high prices. The directors of one company, certainly among the oldest-established, the Coventry Premier, have frankly approached their shareholders with a view to obtaining the sum of £40,000 in second debentures bearing interest at 10 per cent, the debentures being of £10 each, and repayable at a premium of £1 at the rate of £1,000 per annum at least. Apparently, the shareholders have no choice in the matter. A bank overdraft has been refused. Accounts made up to the middle of last year suggest a loss of £41,700 and lower sales may be noted. The molders' strike is once more brought in; for, though castings do not enter so largely into cycle construction as in some other branches of engineering, the company had apparently intended to make up for bicycle losses by building roundabouts.

The fact that the bank had refused further credit in this instance is quite in keeping with present-time practice. Help is refused for any enterprise with character that approximates to the speculative. To add to the troubles of some firms, it is stated that the demand for payment of excess profits duty will be rather more insistent than in the past year or two, accomodation having been to some extent granted as to period of payment, etc., by the tax authorities. Since it was imposed toward the end of 1915, this duty appears to have brought into the exchequer the sum of about £926,347,000.

SHORTAGE OF CASTINGS STILL ON

Shortage of castings as the result to some extent of the molders' strike still shows itself in practically every branch of engineering. It is mentioned at the annual meetings of most engineering concerns: that of Greenwood & Batley, Ltd., Leeds, may be mentioned. Calling recently on about fourteen firms, the writer found only one of them satisfied with present supplies. It is recognized that Great Britain is short of foundry facilities, and up and down the country a number of foundries are being built. Not all of them, however, have been able to find the necessary skilled labor and in some districts the use of machines makes very slow progress.

The shortcomings of Great Britain in foundry work generally are in fact being steadily discovered by the persons concerned. Thus, the Institution of British Foundrymen has decided to take advantage of the government research fund, and will form a research association for the ordinary cast-iron and malleable-iron trades. A census has been taken which suggests that the United Kingdom has about 2,800 foundries, 285 being in Scotland, and 50 in Ireland, with about 800 in the Birmingham district. The necessary offices and also a research laboratory will consequently, it is proposed, be fitted out in Birmingham, under the direction of T. Vickers. So far, every encouragement has been given by the foundry industry, including various workmen's unions, and a meeting of the trade will be held shortly to start the association. Under the government scheme a fund of £1,000,000 is at the disposal of the Department of Scientific and Industrial Research for just such purposes. A similar research association for the motor-cycle and cycle-car industry has just been approved by the department named.

A PROMINENT AMALGAMATION

In the motor industry the amalgamation of the Darracq and Sunbeam companies created a mild sensation. Shares are to be exchanged on an equal basis. The capital of the Darracq Co. is 2½ million pounds, the dividend for some years being about 20 per cent on ordinary shares, with 10 per cent. on the £1,600,000 preferred shares. Of late, debentures had been repaid, and about half a million pounds worth of goodwill has been removed. In addition, the reserve fund is understood to be large. This company purchased the Clement-Talbot Co., and the business of J. Woodhead & Sons, Leeds, who supply springs, etc.; in addition, the company holds the capital of Heenan & Froude, constructional engineers of Manchester and Worcester. The Sunbeam capital is £530,000, £30,000 of that being preference shares, plus debentures at £150,000. The dividends paid range up to 33⅓ per cent. with bonuses, and last year a bonus of 100 per cent. on ordinary shares was distributed from the reserve. The initials of the three motor concerns will appear in the name proposed for the new amalgamation, namely, S.T.D. Motors, Ltd. As far as is at present known the existing works will be maintained.

The Singer Co., too, is to increase its capital to £500,000, and shortly a meeting will be held in order to arrange for the capitalization of about £100,000 from the reserve fund (£90,000) and profit and loss account. It has been stated that want of space is limiting the output possible from the machinery now installed. The present capital is, in fact, the result of a somewhat similar operation three years ago when reserves to the extent of about £50,000 were capitalized. Previous to this, however, the company had twice been reconstructed and the capital considerably reduced.

A number of firms have had their plants, etc., revalued and take credit for it, thus showing of course considerable increase as compared with values estimated even a year or so ago. All the same, many people regard present values

as inflated, and the wisdom of the policy is doubted. Greenwood & Batley, Ltd., at its thirty-second annual general meeting, heard that about £175,000, the capitalization of reserves, had been issued in the shape of bonus shares, and the chairman stated that justification will be found in the increased figure shown in the balance sheet for the value of works and plant. He was careful to point out that "the distribution of these shares in no way increases the earning power of the company." Straker-Squire, Ltd., the well-known motor people, for the year ending with March last made net profits of £46,564, paying a dividend of 10 per cent. That company has also re-valued its plant, etc., the increased value amounting to about £166,000. Of this, nearly £63,000 has been taken to write off goodwill, patent rights, experimental work, etc., the balance has been placed to the capital reserve fund.

The directors in fact believe that the property has risen further in value. They, too, state that but for the molders' strike the profits would have been considerably larger. Further capital is to be raised.

When money values are considered to the exclusion of quantities the returns on British overseas trading during the month of May last are certainly encouraging, suggesting a steady movement toward pre-war conditions. The value of the imports was £166,333,816 or rather more than £30,000,000 higher than the same month of last year. On the other side, exports at £119,319,422 were nearly £55,000,000 up on the same comparison, and made a new record. Improvement is shown in pretty nearly every direction.

A British Empire Exhibition

A British Empire Exhibition will be held in London in 1923, or earlier if possible. At a meeting which was held at the Mansion House, London, E. C., a representative of the Machine Tool Trades Association expressed regret that the government had given approval to a long-period exhibition. "Exhibitions were among the best advertising media, but six months' exhibitions which formed a fair ground were not the best method of promoting British trade." The Cologne trade fair, projected for the coming autumn, has been postponed because, owing to labor troubles, the buildings could not be finished in time. May of next year is the period suggested.

The firm of Harry F. Atkins, Ltd., Old Fletton, Peterborough, will already be known to many American readers through its slotting machines, marketed by Alfred Herbert, Ltd.; a new size of this machine is on the way. The other regular products of the firm include a lathe of 5½ in. height of centers with a head of rather more power than usual, interlocked apron motions, dead stops for length, taper-turning device, etc.

Another machine now regularly made is a twist-drill grinding machine of swinging-arm type, carrying a ring wheel 8½ in. in diameter and suitable for drills of from ¼ to 2¼ in. in diameter. Three lip drills can readily be ground, a small screw limiting the motion of the V arm. Clearance, too, can be adjusted if required. Both the main wheel and the point-thinning wheel at the other end of the spindle are guarded and splashing is prevented. A ground cast-steel spindle is employed and like the countershaft, which forms part of the machine, it is mounted on protected ball bearings. The firm has recently trebled the floor space of its workshops; also it has acquired twelve more acres of land, so that room is not wanting for further developments, which may include a foundry.

Operating in Great Britain at present are at least two systems of surface contact electric traction; namely, at Lincoln and Wolverhampton. The American will be interested in the latter where the Lorain system has been employed since 1900. On account of the heavy operating costs, age, and the need for double tracking, the system is to be displaced by the overhead trolley. Simultaneously to effect double tracking with the surface contact system and maintain running is somewhat difficult. Also the Lorain system necessitates the use of special details of equipment, as against the modern tendency toward standardization. In the interest of inter-communication and economical construction, maintenance and operation, it is concluded that the Wolverhampton tramways must be on the overhead system.

A news item of some interest here lies in the report that two of the largest Austrian screw-making concerns, Brevillier and Urban, have been bought by Guest, Keen & Nettlefolds in conjunction with the Jagy firm, Paris. The statement adds that the Brevillier Co. will enter the international screw syndicate and have a monopoly in east Europe.

Another London firm, W. Cole & Sons, automobile engineers and motor-coach builders, closed down recently, although having something like £400,000 worth of orders in hand. One of the directors has stated definitely that this is because "men did not produce enough work." Despite shortage of workers in the trade, piece-work has been refused. Complaints were made of time lost "by the constant succession of deputations from one or other sections of our employees making new demands." The trade union concerned has denied the complaint that dilution has not been permitted, and stated that the position of the firm is due to orders having been taken immediately after the war ended, thus involving now a revision of prices to make allowance for raw materials, etc. This Hammersmith firm had been established for more than 100 years; it employed about 500 work-people of all kinds, with an average weekly wage bill of about £3,000.

Hourly Output of Workmen Put at 60 Per Cent of Normal

One of the latest voices to be raised in connection with reduced outputs is that of Sir Arthur Duckham, who in his presidential address before the Society of British Gas Industries, at Sheffield on June 15 estimated that the hourly output of the average workman was in 1919 about 70 per cent of the figure for 1914, and at the present day he put the output at about 60 per cent. As a remedy for present-day evils he joined those who press for an industrial parliament. Apparently, this parliament is to be a council of representatives of employers' federations and workers' unions, so that limitations which are apparent in the Whitley councils would be once more seen. In fact, he admits that for true representation "all workers and all employers must be brought within the fold of unions of workers or federations of employers." These councils seem chiefly to be concerned with the arrangement of wages, a matter of no great difficulty when almost any price can be obtained for the article produced. No guiding principle appears, and in fact each trade or industry thinks only of itself. The same is true of a number of associations of semi-technical character which have been started-up for the smaller, and in some cases larger, industries. Sooner or later they become mere price maintenance associations.

Meanwhile, despite means as to reducing output and crushing taxation, it seems still to be possible to carry on all the usual horse racing (though perhaps not everybody attending) as a regular thing, a producer. America is encouraging us in the same direction by sending to us her best performers in golf and tennis. Well, all work and no play, etc.

Unusual Drilling in Chrome Nickel Steel

At the exhibit of the Railway Manufacturers Association, held at Atlantic City, June 9 to 16, demonstrations in drilling alloy steels, were productive of noteworthy results.

On an American 6-ft. radial, open hearth chrome nickel steel (0.50 carbon, 0.90 chromium, 1.00 nickel, 0.75 manganese) was drilled at the rate of 20 in. actual penetration per minute, with 1 in., 1¼ in. and 1½ in. Hercules high-speed drills, made by the Whitman & Barnes Manufacturing Co., Akron, Ohio. The drills were run at 500 r.p.m. with a feed of 0.04 in. per revolution.

Holes 3 in. deep were drilled in 9 sec., attaining a penetration of 1 in. every three seconds, a remarkable performance in drilling steel of this character.

SPARKS FROM THE WOR

Valentine Francis

Commerce Chamber Visit to Russia Held Up By Passport Ban

No final action has yet been taken toward the selection of a commission by the Chamber of Commerce of the United States to visit Russia to investigate trade possibilities. Authorization for the appointment of such a commission was made at the annual convention of the Chamber at Atlantic City last Spring.

It was stated recently that the project has not been abandoned, and that a commission probably will be sent at a later date. The subject was taken up with the State Department some time ago as to whether passports would be granted to permit the members of the commission to enter Russia. The State Department officials informed the Chamber that no passports are being issued to Russia. Under these circumstances the commission may go to countries adjacent to Russia without attempting to cross its borders.

The recent relaxation of restrictions on trading with Russia apparently has not given sufficient impetus to the movement for resumption to trade to hasten the departure of the commission for Europe. It is expected, however, that such a commission will be appointed before long, perhaps by the time this appears in print. The selection of members of the commission, it is understood will be made upon the suggestion of the Russian-American Chamber of Commerce, of which former Secretary of Commerce William C. Redfield is president.

Industrial Research Laboratories in America

A bulletin just issued by the National Research Council lists more than three hundred laboratories maintained by industrial concerns in America, in which fundamental scientific research is carried on. The bulletin gives a brief account of the personnel, special equipment and particular kind of research carried on in each of the laboratories listed.

Industrial research laboratories have increased notably in number and activity, both in America and Great Britain, since the beginning of the war, because of the lesson vividly taught by the war emergency. It was only by a swift development of scientific processes that the Allies and America were able to put themselves in a position first to withstand and then to win a victory over Germany's science — backed by armies and submarines. And it is only by a similar and further development that America and the Allies can win over Germany in the economic war-after-the-war, now being silently but vigorously waged.

Motor Truck Opening New Profit Channels

"What the railroad did following the Civil War to open up new channels of industry and profit, the motor truck is doing today," declares J. J. Hunt, general manager of the Reo Motor Car Co., of New York.

"Naturally," he stated, "the motor truck cannot hope, nor do its owners wish it, to supplant the railroads, except on short hauls. On long journeys the rail way is the cheapest way.

"Since the war the increase in sales and production of motor trucks has been unusually great. During 1919, for example, 316,364 trucks were built, an increase of 39 per cent over figures for the previous year."

Airplane Service Between Amsterdam and London

An airplane service with the English "Airco" machine has been established between Amsterdam and London. The transit time, between three and four hours, is about a sixth of the time consumed in going from Amsterdam to London by the usual railroad and steamer route.

The airplanes fly overland from Amsterdam to Calais, France, and then cross the Strait of Dover at the narrowest point, being only about 10 min. above water. The return voyage is by the same route. As it is approximately 400 miles, the airplanes travel at least 100 miles an hour.

The passenger fare between Amsterdam and London is 150 florins ($60.30). First-class fare, with meals and cabin on the steamer, by the usual route is about half that amount.

Packages are carried by the airplanes for the equivalent of $1 per kilo (2.2 pounds) up to 5 kilos. For greater weights, the rate per kilo declines till the charge for 40 kilos (88 pounds) is $29. Packages weighing more than 40 kilos and measuring more than half a yard on any side are not carried except by special agreement.

During 1919 the value of the declared exports from Switzerland to the United States, amounting to $54,757,686, nearly tripled that of the preceding year, $18,681,792. The most important increase occurred in shipments of watches, totaling $25,244,239 in the past year as compared with $8,248,370 in 1918.

Plant That Helped Equip Monitor Changes Hands

Memories of the ironclad Monitor of Civil War fame are recalled in the recent sale of the site and plant of the Hewes & Phillips Iron Works at Orange and Ogden Sts., Newark, N. J., for it was there that the turret rings and a machine for planing the turrets of the fighting craft were made. The part the local industry had taken in equipping the boat which prevented the Merrimac from wreaking havoc among the Northern ships was always a source of pride to the late John M. Phillips, one of the company's founders.

There, too, at cost, 8,000 stands of arms were altered for the state from flintlock to patent breech and percussion guns at the beginning of the war. Twelve thousand stands of arms were altered by the company for the Federal Government. The plant also manufactured the motive machinery for the "Modoc," the "Cohoes" and other light ironclads and large quantities of machinery for gun factories throughout the country. It sent more than threescore of its workers into the Union forces.

The business was founded in New York in 1845 by Mr. Phillips and J. L. Hewes, and consisted of the manufacture and sale of steam engines, boilers and various machines. In the following year it moved to Newark, having for a time occupied a building at Bridge and Spring Sts. The present site was purchased in 1858. It shipped its products to all parts of the globe.

Mr. Phillips had been a pattern-maker's apprentice at sixteen years. Later he was identified with Seth Boyden, the inventor. The heirs of his partner sold their share to Mr. Phillips in 1873, and the plant has since remained in the Phillips family.

The property was sold by the Phillips estate, represented by Alfred F. Skinner, to the New Jersey Machinery Exchange.

5,530 Cars for Canada Roads

Among the list of new equipment just ordered by the Canadian National Railways are 112 new locomotives, 4,150 freight cars, 600 refrigerator cars, 350 ballast cars and 350 stock cars. Eighteen new sleepers, 12 new diners and 50 express refrigerators have also been ordered.

Of the new locomotives, 32 are medium Pacifics, 10 are heavy Pacific, 25 are Santa Fes, 25 are switch engines and 15 Mikados. The list of freight cars consists of 1,150 general service cars and 3,000 box cars. Delivery on the new equipment will begin shortly.

LD'S INDUSTRIAL FORGE
News Editor

Southeast Machinery Exports to Latin America Increasing

Machinery and machinery supplies have contributed considerably to the remarkable development of the export business between the Southeast and the Latin-American countries during the past two or three years, according to Dr. Guy King, Cuban consul in Atlanta. Atlanta alone this year, Dr. King stated, would have an export business with Cuba amounting to about $1,250,000, of which amount machinery and supplies is one of the main products represented. In 1919 Atlanta's export business with Cuba amounted to a little less than $1,000,000, and the increase this year is proportionate with the increase in export business being experienced generally throughout the Southeast, the consul declared.

World's Biggest Blast Furnace Is Blown In

The Ebbvale Co., London, England, has blown in what is said to be the world's biggest blast furnace. The furnace cost £1,000,000.

The weekly output is estimated at 3,000 tons. It is asserted that the furnace can produce steel the cheapest in the world.

Starts New Business With Prayer

The unusual proceeding of starting a great business enterprise with a prayer meeting was witnessed recently. The Meadows Manufacturing Co., Bloomfield, Ill., which has just completed a quarter-million dollar plant, assembled all heads of departments and sales managers in the offices and called in a minister to conduct an old-fashioned prayer meeting as marking the official dedication of the new plant.

About the Gasoline Supply

Henry L. Doherty says: "There'll be gasoline for us, for our children and our children's children."

The United States Geographical Survey says: "Seven billion six hundred and twenty-nine million barrels of oil still in United States fields—enough for 20 years at present consumption rate. World's deposits 60,000,000,000 barrels —enough for 168 years.

The United States Bureau of Mines reports: Reserve gasoline stocks in March reached 625,393,046 gallons, an increase in 30 days of 80,330,617 gallons. Surplus of production of gasoline, 1919, 149,446,488 gallons. Total production of gasoline in 1919, 3,957,857,097 gallons.

S. F. Bowser & Co. Has Sales Convention

S. F. Bowser & Co., Inc., Fort Wayne, Ind., manufacturer of oil tanks, pumps and storage systems, held its annual sales convention from June 28 to July 2 inclusive in honor of the 1919 members of the company's Pacemakers Club. Membership in this club is a reward for securing 500 points of business based on volume and class of equipment sold.

The convention was held for the benefit of the sales force and to secure co-operation from the factory force. As a surprise to the latter group, the salesmen pinned on the bosom of each workman a "badge of honor." A gasoline-filter demonstration of the Bowser filter was also successfully conducted. The convention was said to be the largest and most successful ever held and indicates the great co-operation existing among Bowser employees.

WAYNE ENGINEERING CO.

DESIGNING AND MANUFACTURING ENGINEERS

HONESDALE, PA., July 12, 1920.

"The Price of Meters for the Small Shop"

During the past few months, the writer has given serious consideration to the possibility of our company being one of the victims of the World Trade Club. Our concern is small, having been in existence only a few years, and the successes we have attained have been the result of constant plugging in the improvement of our small tools, jigs and fixtures. These are a large and important factor in producing, and without having this equipment in daily use we could not earn a penny. We have not the time nor money to rebuild and replace them to produce a product to metric measurements, though the metric system might be the finest in the world(?). Such a shift would mean financial disaster which no one desires, and the success of this absurd project would stand fair to eliminate us. And we think the great fraternity of small shops feel the same way about it.

W. BURR BENNETT,
President.

Commander Gatewood Now Director of Construction and Repair

Commander R. D. Gatewood of the Construction Corps, U. S. Navy, has been selected by Chairman Benson as director of construction and repair of the Emergency Fleet Corporation, relieving R. L. Hague, of San Francisco. Commander Gatewood graduated from the Naval Academy in the class of 1903 and from the post graduate course of Naval Architecture and Marine Engineering at Massachusetts Institute of Technology in 1906. He has been in charge of repairs and new construction on both the Atlantic and Pacific coasts and for two and one-half years was fleet constructor of the North Atlantic Fleet.

During the war Mr. Gatewood was superintendent of motive power for the Panama Railroad in charge of the large shops and drydocks at both ends of the Isthmus and made an enviable record in connection with extensive repair and refitting work on merchant vessels.

Shortage of Gasoline in the German Automobile Industry

[Consul Frederick Simpich, attached to American Commission, Berlin, June 2, 1920.]

In a recent general meeting of the Society of German Motor Car Manufacturers complaint was made that sales are badly blocked by the shortage of gasoline; that the importation from the United States is, in spite of very considerable orders, most unsatisfactory, seemingly on account of an enormous consumption in the United States; that it is hoped that Roumania will soon be able (as in former times) to again take up its gasoline export to Germany.

In the course of the meeting it was further stated that it was planned to work hand in hand with the Austrian automobile industry concerning all economic questions.

Deny Russia Purchased Engine Company

Olof H. Lamm, Swedish Consul General at New York, has issued a formal denial of the statement that Nydquist & Holm, Aktiebolag of Trollhaettan, the largest locomotive works in Sweden, has been sold to Russia.

"Although the majority of the shares of the company have recently changed hands, I can authoritatively inform you that there is no Russian interest behind this transaction, the new shareholders being all Swedes," he said.

Obituary

B. F. MECHLING, president of the Albro-Chemical Elevator Co., died on July 2 at his home in Philadelphia, Pa. Mr. Mechling received his education in Allentown Seminary (now Muhlenburg College). He was president of the Elevator Safety Appliance Co., Philadelphia, and a director of Mechling Bros., Camden, N. J. He has been president of the Albro-Chemical Co. for twenty-seven years.

Personals

At the meeting of the trustees of the United Engineering Society on June 24, IRVING E. MOULTROP, 39 Bolyston St., Boston, as a trustee of American Society of Mechanical Engineers, was elected a member of Engineering Foundation Board to fill the vacancy caused by the death of E. Gybbon Spilsbury.

J. E. JOHNSON, formerly secretary and treasurer of the Waterloo Gasoline Engine Co., Waterloo, Iowa, has accepted the positon of professor of practical Christianity in Boston University.

E. R. HONEYWELL, of New York, has been selected as manager of the Hares Motors Corporation of Connecticut, at the Locomobile factory in Bridgeport, Conn., succeding M. A. POLLACK, who resigned recently.

JOSEPH S. SAMPSON has been appointed traffic manager of the Wickwire-Spencer Steel Corporation's plant in Worcester, Mass.

A. H. GRAYBURN, for the past four years assistant to the vice president of the Norma Co. of America, Long Island City, N. Y., has been made assistant secretary and assistant treasurer of that concern.

EDWARD E. BRITIGAN, for a number of years connected with the American Die and Tool Co., Reading, Pa., in the capacity of engineer, has severed his connection with that company. After a short vacation he will follow machinery and automotive sales or service work.

NORMAN BELL has been made assistant sales manager for the Norma Co. of America, Long Island City, N. Y., this appointment following a connection of over three years with the concern as sales engineer. Mr. Bell's training and experience in the mechanical and automotive fields includes a former association with a leading British manufacturer of motor cars, and nearly four years in charge of the motor-accessories department of the Lunkenheimer Co., of Cincinnati.

A. J. STRONG, who has been for a number of years with the Pratt & Whitney Co. and later with Motch & Merriweather Co., Detroit, has become sales manager of the Detroit branch of the Whitcomb-Blaisdell, Reed-Prentice and Becker Milling combination. This combination was announced in a recent issue.

MESSRS. A. H. MITCHELL and E. R. ABBOTT, formerly with H. W. Cotten, Inc., have become associated with the Coe-Stapley Manufacturing Corporation, of West Haven, Conn. They will make their headquarters at 136 Liberty St., New York City, and will be in charge of the contract sales work of the company, covering quantity production of sheet-metal products, stamped, drawn or pierced work, or sheet-metal specialties completely assembled, of any metal and any finish. They will specialize particularly in work covering the manufacture of sheet-metal parts for automobiles, motorcycles, electrical devices, automobile accessories, phonograph motors and parts, clocks, etc.

Business Items

The Titan Tool Co., Erie, Pa., is the name of an organization recently formed to manufacture precision drilling and threading tools. F. A. Veith is president; J. V. Walker, treasurer; C. J. Gaugh, secretary, and J. W. McKean, vice president. These men were all formerly connected with the Modern Tool Co., Erie, Pa.

M. A. Hanna & Co., Cleveland, Ohio, has leased the property of the Buffalo Union Furnace Co., according to an announcement recently made by Frank P. Baird, president of the company. The period of lease extends for four years. C. A. Collins, second vice president of the Buffalo concern, will be retained as operating executive by the lessees. Mr. Baird said the transfer was made as a result of his desire to retire. This change will not effect the personnel or the general trade of the concern.

The new four-story addition to the Union Twist Drill Co., at Athol, Mass., will be finished shortly and will add approximately 48,000 sq.ft. of floor space to the present manufacturing space. The new addition is 63 x 190 ft. and of brick construction.

The opening of the new plant of the New Departure Manufacturing Co., at Meriden, Conn., on June 29 was celebrated by an entertainment attended by 6,000 people. This plant will be known as plant "D." It comprises several large modern buildings, power plant, administration, etc.

The Eagle Rock Tool and Die Co., West Orange, N. J., was incorporated with a capital of $100,000 to manufacture and deal in tools, etc.

Catalogs Wanted

The Standard Equipment and Tool Works, 179 St. James St., Montreal, Can., would be pleased to enter into correspondence with manufacturers of a few good lines who wish to enter the Canadian field.

Trade Catalogs

Portable Boats of Early Railroad Practice. The Baldwin Locomotive Works, Philadelphia, Pa. Record No. 97, pp. 35, 9 x 6 in. This booklet is written by J. Snowden Bell. It tells how the early method of transportation of freight and passengers between the cities of Philadelphia and Pittsburgh was successfully conducted in canal boats, which traversed the entire distance between these terminals partly on railroads and partly by canal.

Like Finding Money. Famous Manufacturing Co., East Chicago, Ind. Catalog, pp. 13, 4 x 9 in. This catalog illustrates and describes the "Famous" waste-paper baling press and the company's belt or motor-power press which is used for baling paper, cotton waste, hides, etc. It also illustrates the sheet-metal scrap busheling press which compresses into a compact mass all kinds of sheet-metal scrap, lathe cuttings, shear trimmings, metal chips, punchings, etc.

Flexible Steel Armored Hose. Sprague Electric Works of General Electric Co., 527-531 West 34th St., New York. Bulletin No. 44,552., pp. 19, 8 x 10½ in. This bulletin contains illustrations and descriptive matter of the various uses of its steel-armored hose for railroads. List prices and specifications are also given.

Machine-Tool Control. The Cutler-Hammer Manufacturing Co., Milwaukee, Wis. Booklet, pp. 48, 8½ x 11 in. The first half of the book is devoted to machine tools of all kinds—lathes, drills, boring machines, planers, milling machines, punch presses, etc., with suggestions for the selection of motor and control apparatus for the different machines. The second half of the book takes up the C-H controllers.

Lifting Magnets. The Cutler-Hammer Manufacturing Co., Milwaukee, Wis. Pamphlet, pp. 8, 8½ x 11 in. This company has issued a new pamphlet describing and illustrating its circular type of lifting magnets. It tells how many iron foundries, steel mills, shipyards, and other plants are increasing production and reducing handling costs by the use of the circular type of lifting magnets.

Tools and Machinery Supplies. Peter A. Frasse & Co., 417 Canal St., New York. Catalog, 6 x 9¼ in., pp. 800. Peter A. Frasse & Co. has announced that it has issued its first large general catalog since starting business. This catalog is printed on coated stock with cloth board covers. There are several sections. The first contains illustrations and descriptive matter on tool and alloy steel, cold-drawn steel, screw stock and shafting. The next section is devoted to complete information on Shelby cold-drawn mechanical steel tubes. This is followed by sections on transmission chains made by Renold Ltd., Manchester, England, and machinist's tools, general supplies, etc.

Forthcoming Meetings

The International Railway Master Blacksmiths' Association will hold its next annual convention at Tutwiler Hotel, Birmingham, Ala., on Aug. 17, 18 and 19. The secretary of the association is A. L. Woodworth, Lima, Ohio.

The National Gas Engine Association, Monadnock Bldg., Chicago, Ill., will hold its thirteenth annual convention at the Congress Hotel, Chicago, on Sept. 1, 2 and 3.

The American Steel Treaters' Society and the Steel Treating Research Society will hold their second annual convention and exhibition at the Commercial Museum, Philadelphia, Pa., on Sept. 14 to 18, inclusive. J. A. Pollack, of the Pollak Steel Co., Cincinnati, Ohio, is secretary of the former society.

The American Foundrymen's Asssociation will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Rush Terminal Sales Building, 132 West 42nd St., New York.

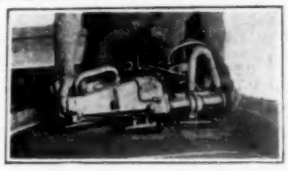
Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Rubbing Machine

Franklin Products Co., Inc., Syracuse, N. Y.

"American Machinist," July 1, 1920.

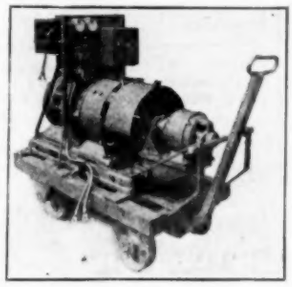


The machine is intended to supplant hand rubbing in paint shops and the claim is made for it that by its use twice as much work can be done as by hand rubbing. The machine has two feet, or kickers, working in opposite directions and uses compressed air as a propellant. The construction of the rubbing feet makes it possible to rub on uneven on rounded as well as on flat surfaces. The frame and all parts possible are made of aluminum and the total weight is but 20 lb. The machine can be used on both vertical and horizontal surfaces. It uses the same materials as are used in hand rubbing.

Welding Outfit, Single-Operator Electric

Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.

"American Machinist," July 1, 1920.

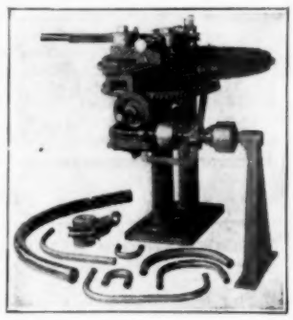


The generator operates at arc voltage and no resistance is used in circuit with the arc. It is designed to inherently stabilize the arc and has a rated capacity of 175 amperes. Twenty-one steps provide a current regulation of less than 9 amp. per step and make it easier for a welder to do vertical or overhead work. For portable service, the set with control panel is mounted on a fabricate steel truck, equipped with roller bearing wheels. The generator is compound-wound, flat compounded, that is, it delivers 60 v. at no-load and also at full-load. Either d.c. or a.c. motors can be supplied. Where an a.c. motor is used, leads are brought outside the motor frame for connecting either 220- or 440-volt circuits.

Bending Machine, Wallace 5 A

Wallace Supplies Manufacturing Co., 412-20 Orleans St., Chicago, Ill.

"American Machinist," July 8, 1920

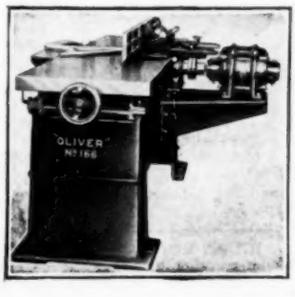


The machine is controlled by a lever that engages friction-clutch pulleys for forward and reverse and is provided with adjustable stops to suit any degree of bend required. To bend angles, channels and similar material, it is first necessary to make a form and follower bar of correct shape. The material to be bent is clamped to the form, the follower bar operating between the material and roller. The roller bracket for follower bar is adjustable to and from the center providing a range of circular bends as large as 25 in. radius. The pipe bending equipment includes four standard forming heads suitable for pipe ranging in size from 1 to 2 in. These heads will form bends of 90 deg. Machine weighs 1,200 lb.

Jointer, Hand Planer and

Oliver Machinery Co., Grand Rapids, Mich.

"American Machinist," July 8, 1920

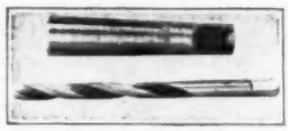


The machine shown herewith, known as No. 166, is arranged so that a d.c. motor or an a.c. motor for one, two or three phase in various voltages can be furnished. In other respects the machine is the same as described in the "American Machinist," of July 17, 1919.

Chuck, "Wearever" Drill

Scully-Jones Co., Railway Building, Chicago, Ill.

"American Machinist," July 1, 1920.

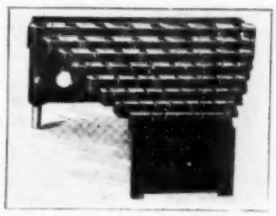


The object of this chuck is to provide a taper shank which can be used to hold a straight shank drill in the taper hole of a drilling-machine spindle. The only operation necessary to prepare a drill for use in this chuck is to grind a flat spot on the end of the shank. One advantage claimed for this chuck is that when used in a multpile-spindle drilling machine, drills can be spaced much closer than if held in the ordinary type of drill chuck. The chucks are made with tapers to suit all standard drilling-machine spindles and with holes to fit all sizes of straight-shank drills.

Drill Rack, Gaging

Peerless Machine Co., Racine, Wis.

"American Machinist," July 1, 1920.

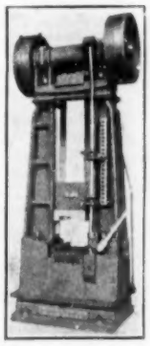


The drills are placed in the holes with their points downward. The holes go clear through the rack and each hole is of two diameters, the first part being the nominal diameter of the drill it is intended to hold and the latter part the diameter of the next smaller drill in the set. A drill larger than the first part of the hole will not enter and a smaller drill will fall through, but a drill of the right size will enter the hole intended for it a certain distance, where it will be stopped by the smaller diameter of the hole. Thus a drill that will enter a hole and stay there is necessarily in its right place. The racks are made in seven sizes, the smallest for drills $\frac{1}{8}$ to $\frac{3}{4}$ in. and the largest for drills $\frac{41}{64}$ to $1\frac{1}{4}$ in.

Hammer, American Drop

Long & Allstatter Co., Hamilton, Ohio.

"American Machinist," July 8, 1920



The increased distance between V-guides permits use of extra wide dies. The frame adjustment for aligning the upper and lower dies is designed for a movement of 0.004 in. and is prevented from loosening by a positive automatic arrangement. The weight of the anvil in proportion to that of the falling ram is approximately fifteen to one, and means are provided for recording the various heights at which the ram should be released for each set of dies, thus assuring duplicate work at different periods. The hammer is made in eight sizes, with falling weights ranging in sizes from 100 to 1,200 lb.

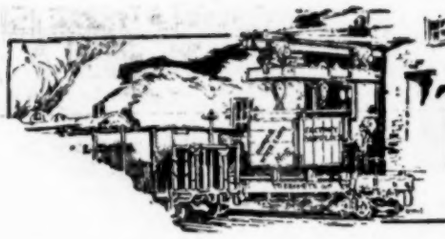
Motor, Westinghouse, "HK"

Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

"American Machinist," July 8, 1920

The d.c. series wound motor is of inclosed construction with small openings in the lower part for ventilation. Covered openings in the top half of frame give access to brushes and commutator. The motor has a forged open-hearth steel frame and solid forged-steel feet, and when above 3 hp. rating is equipped with commutating poles so that high momentary loads can be carried without series sparking. A blower is placed in the rotor which ventilates both armature and field windings. Electrically operated, shoe-type brakes are supplied when ordered. They are bolted to the machined lugs on the motor bracket, making a compact unit of motor and brake.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$45.60	$29.80
Northern Basic	42.80	27.55
Southern Ohio No. 2	46.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	49.65	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	49.70	33.95
BIRMINGHAM		
No. 2 Foundry	42.00@44.00	25.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25-2.75 sil.	46@48.25*	30.65
Virginia No. 2	45.00*	30.85
Basic	44.50†	29.90
Grey Forge	43.50*	29.90
CHICAGO		
No. 2 Foundry local	44.25	27.25
No. 2 Foundry, Southern	47.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	45.65	28.15
Basic	44.40	27.15
Bessemer	44.90	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.47	$3.97	$3.47	$5.50	$3.37	$3.97	$3.47
Soft steel bars	4.62	4.12	3.37	5.00	3.27	3.87	3.37
Soft steel bar shapes	4.62	4.12	3.37	.....	3.27	3.87	3.37
Soft steel bands	6.32	5.32	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.67	4.17	3.67	5.00	3.57	4.17	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.75
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.22
Warehouse, Chicago	3.75	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55-7.00	7.12@8.00	4.57	7.55	7.02
No. 12	3.60-7.65	7.17@8.05	4.62	7.65	7.07
No. 14	3.65-7.10	7.22@8.10	4.67	7.70	7.12
No. 16	3.75-6.20	7.32@8.20	4.77	7.80	7.22
Black					
Nos. 18 and 20	4.20-6.20	7.80@9.50	5.17	8.20	7.80
Nos. 22 and 24	4.25-6.25	7.85@9.55	5.22	8.25	7.85
No. 26	4.30-6.30	7.90@9.60	5.27	8.30	7.90
No. 28	4.35-6.35	8.00@9.70	5.37	8.40	8.00
Galvanized					
No. 10	4.70-8.00	8.55@11.00	5.50	8.50	8.15
No. 12	4.80-8.10	8.65@11.00	5.55	8.60	8.20
No. 14	4.80-8.10	8.65@11.10	5.60	8.60	8.35
Nos. 18 and 20	5.10-8.40	8.90@11.40	5.90	8.90	8.65
Nos. 22 and 24	5.25-8.55	9.05@11.55	6.05	9.05	9.05
No. 26	5.40-8.70	9.20@11.70	6.20	9.20	9.20
No. 28	5.70-9.00	9.50@12.00	6.50	9.50	9.50

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.25	$5.80	$6.00
Flats, square and hexagons, per 100 lb. base	6.75	6.30	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$20.00	$15.50-19.00
Cleveland	20.00	20.00
Chicago	21.00	19.00

In coils an advance of 50c. usually is charged

Domestic iron (Swedish analysis) is selling at 12c. per lb.

WELDING MATERIAL (SWEDISH)—These prices are the best we have been able to obtain for Swedish welding materials, of which it is reported that very little are on the market.

Welding Wire		Cast-Iron Welding Rods	
⅛, 5/32, 3/16, 1, 5/16, 3/8, No. 8, 7/16 and No. 10	21.00 to 30.00	1/4 by 12 in. long	14.00
½, No. 12, 9/16, No. 14 and 5/8, No. 18, No. 20		¼ by 19 in. long	12.00
		⅜ by 19 in. long	10.00
		½ by 21 in. long	10.00
		Special Welding Wire, Coated	
		⅛	33.00
		3/16	30.00

Domestic—Welding wire in 100-lb. lots sells as follows, f. o. b. New York: 3/16, 8½c. per lb.; ⅛, 8c.; 5/32 to ¼, 7½c.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.00
Spring steel (light)	10.00	11.00	12.25
Coppered bessemer rods	9.00	8.00	6.75
Hoop steel	6.57	6.50	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.80	6.00	6.77

PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card, discounts on steel pipe, applying as from January 14, 1920, and on iron pipe from January 7, 1920.

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛ to 3	54-57½%	41½-44%	¼ to 1¼	24½-34½%	8 -18½%
LAP WELD					
2	47 -50½%	34½-38%	1¼	.....	.....
2½ to 6	50 -53½%	37½-41%	1½	.....	.....
7 to 12	47 -50½%	33½-37%	2	20½-28½%	6½-14½%
13 to 14	37½-41 %	.....	2½ to 6	22½-30½%	9½-17½%
15	35 -38½%	.....	7 to 12	19½-27½%	6½-14½%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛ to 1¼	52 -55½%	39½-43%	¼ to 1¼	24½-34½%	9½-19½%
2 to 3	53 -56½%	40½-44%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45 -48½%	33½-37%	1¼	.....	.....
2½ to 4	48 -51½%	36½-40%	1½	.....	.....
4½ to 6	47 -50½%	35½-39%	2	21½-29½%	8½-16½%
7 to 8	43 -46½%	29½-33%	2½ to 4	23½-31½%	11½-19½%
9 to 12	38 -41½%	24½-28%	4½ to 6	22½-30½%	10½-18½%
			7 to 8	14½-22½%	2½-10½%
			9 to 12	9½-17½%	5½-+2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅛ to 3 in. steel butt welded	40%	24%	40%	31%	54%40%	40½@30 %
2½ to 6 in. steel lap welded	35%	20%	42%	27%	50@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 32%. Cast iron, standard sizes, net.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	19.00	19.25	21.75
Tin in 5-ton lots	50.25	61.50	70.00
Lead	8.50@8.75	9.00	5.50
Spelter	8.25	8.70	8.00
ST. LOUIS			
Lead	8.15	8.87½	5.15
Spelter	7.90	8.37½	7.15

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

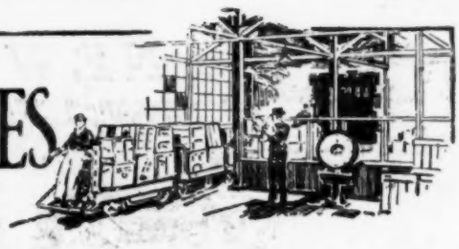
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago April 8 Current	Chicago April 8 Year Ago
Copper sheets, base	33.50	33.50	27.50	32.00	28@30	36.00	27.00
Copper wire (carload lots)	31.25	31.25	24.00	29.50	26.50	27.00	23.00
Brass sheets	28.50	28.50	23.00	29.00	27.00	27.00	21.50
Brass pipe	33.00	33.00	34.00	34.00	35.00	35.00	31.00
Solder (half and half) (case lots)	38.00	33.00	45.00	40.50	41.00	38.00	39.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	25.00	19.00
New York	27.00	21.50
Cleveland	27.00	24.00
Chicago	26.00	24.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound prevail:
Carload lots f.o.b. mill..... 12.00

	—In Casks— Current	One Year Ago	— Broken Lots — Current	One Year Ago
Cleveland	15.00	12.95	15.50	13.30
New York	14.00	12.00	14.50	13.00
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	8.00	8.37½
Chicago	9.50	10.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	— New York — Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	16.00	16.75	16.50	15.50
Copper, heavy, and wire	15.25	15.75	16.50	15.00
Copper, light, and bottoms	13.00	13.50	15.00	14.00
Lead, heavy	7.00	4.62½	7.00	7.00
Lead, tea	5.00	3.75	5.00	6.00
Brass, heavy	10.25	10.00	12.50	15.50
Brass, light	7.50	8.00	10.00	9.50
No. 1 yellow brass turnings	8.50	9.00	10.00	9.50
Zinc	5.25	4.25	5.00	9.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	33.00	34.00c.@35.00c.	33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	30.00	25.00
Chicago	29.00	28.00
Cleveland	32.00	28.50

BABBITT METAL—Warehouse price per pound:

	—New York— Current	One Year Ago	—Cleveland— Current	One Year Ago	— Chicago — Current	One Year Ago
Best grade	90.00	90.00	74.50	79.00	60.00	75.00
Commercial	50.00	50.50	21.50	17.50	15.00	15.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	— New York — Current	One Year Ago	— Cleveland — Current	One Year Ago	— Chicago — Current	One Year Ago
Hot pressed square	+ $6.00	$3.25	$ .75	$1.90	$ .50	2.00
Hot pressed hexagon	+ 6.00	2.70	.75	1.90	.50	2.00
Cold punched hexagon	+ 6.00	3.25	.75	1.90	.50	1.30
Cold punched square	+ 6.00	2.70	.75	1.90	.50	1.30

Semi-finished nuts, ⅞ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50-10%
Chicago	50%	50%
Cleveland	50%	60-10-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	+ 20%	20%	20%
Larger and longer up to 1¼ in. by 30 in.	+ 20%	20%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:
For wrought-iron washers:
New York..... list Cleveland..... $3.00 Chicago..... $3.00
For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:
New York..... $7.00 Cleveland..... $4.50 Chicago..... $4.75

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	+ 20%	15%	10%
Larger and longer up to 1 in. by 30 in.	+ 20%	10%	5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets Current	One Year Ago	Burs Current	One Year Ago
Cleveland	20%	25%	10%	10%
Chicago	net	10%	net	10%
New York	25%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	List Net	30%	30%
Tinned	List Net	30%	30%

Boiler, ½, ⅝, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York..... $6.00 Chicago..... $5.62 Pittsburgh..... $4.50
Structural, same sizes:
New York..... $7.10 Chicago..... $5.72 Pittsburgh..... $4.60

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	34.00	34.00	35.00
Brass	33.00	34.00	34.00

The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities from 10-25 lb., extra is 10c.; less than 10 lb., add .15-20c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ½-2 in. inclusive in rounds, and ½-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $12.50 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	— New York — Current	One Year Ago	Cleveland	Chicago
White	11.00@15.50	13.00	16.00	11.00 to 14.00
Colored mixed	7.00@10.50	9.00-12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.00	$3.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	2.50	2.50	2.75
Chicago	2.25	2.50	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.90	$3.90	$3.65
Philadelphia	3.65	3.65	3.62
Chicago	5.00	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	July 8	July 1	June 24
Prompt furnace	$17.50@$18.50	$17.50@$18.50	$15.00@$16.00
Prompt foundry	18.00@19.00	18.00@19.00	16.00@17.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

	— New York — Current	One Year Ago	— Chicago — Current	One Year Ago
Raw in barrels (5 bbl. lots)	$1.58	$1.15	$1.95	$2.27
5-gal. cans (without cans)	1.60*	2.28	2.15	2.47

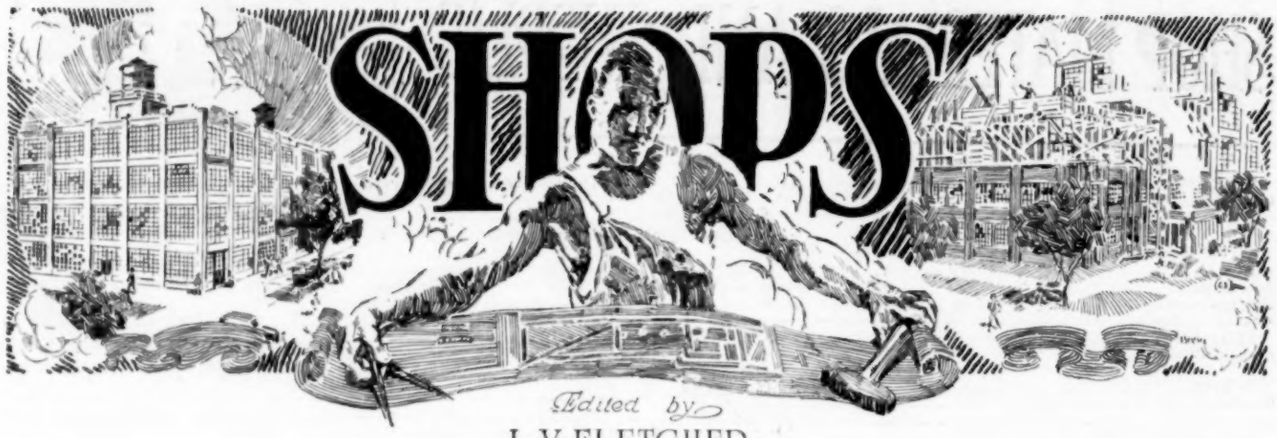
*To this *oil* price must be added the cost of the cans (returnable), which is $2.25 for a case of six.

WHITE AND RED LEAD—Base price per pound:

	— Red — Current Dry	Current In Oil	One Year Ago Dry	One Year Ago In Oil	— White — Current Dry and In Oil	One Year Ago Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13.00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13.25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18.50	20.00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16.00	17.50	20.50	16.00

500 lb. lots less 10% discount. 2000 lb. lots less 10-2½% discount.

NEW and ENLARGED



Edited by
L·V·FLETCHER

Machine Tools

The following concerns are in the market for machine tools:

N. Y., New York (Borough of Manhattan)—The Barney's Automobile Parts Co., 236 West 59th St.—universal milling machines and key seaters.

N. Y., New York (Borough of Manhattan)—The De Lavergne Machine Co., East 138th St.—one boring machine.

N. Y., New York (Borough of Manhattan)—The U. S. Gauge Co., 67 Wall St.—machine tool equipment for Sellarsville, Pa., plant.

N. Y., Rochester—The T. H. Symington Co., Lincoln Park Wks.—one 8 spindle adjustable drilling machine.

Pa., Philadelphia—The Stokes Machine Co., 17th and Cambria Sts.—machine shop equipment.

Ga., Columbus—J. L. Couch Co.—lathes, tools, etc.

Ky., Louisville—The Louisville Motor Co.—repair shop equipment.

Va., Richmond—J. T. Disney & D. J. Cole, Murphy Hotel—repair shop equipment.

Va., Richmond—The Forbes Garage Co., 1312 West Broad St., W. P. Forbes, Purch. Agt.—complete repair shop equipment.

Va., Richmond—The Monte Stone Garage Co., 1310 West Broad St., W. L. Stone, Mgr.—complete equipment for garage and repair shop.

Va., Richmond—The Transportation Motor Co., 1410 West Broad St., A. H. Reinach, Purch. Agt.—repair shop equipment including one lathe.

Va., Roanoke—The Virginia Iron, Coal and Coke Co.—lathes, drills, planers, etc., for Toms Creek shops.

Ill., Chicago—J. Bricken, 2125 North Halsted St.—one plain milling machine.

Ill., Chicago—F. Hildman, 107 North Market St.—one 12 to 14 in. lathe.

Ill., Quincy—The Wall Pump and Compressor Co., Box 381—
One 16 in. x 8 ft. lathe with taper attachment.
One 3 in. radial drill.
One sensitive and one 20 in. Barnes drill.
One 18 or 20 in. crank shaper.
One No. 3 plain and one No. 2 universal milling machine.
One 18 and one 20 in. turret lathe.
One No. 0 Mitts & Merrill keyseater.
Power saw, tool grinder, emery wheel stands, etc.

Ind., Elkhart—The Bueschal Band Instrument Co.—one small bench polishing lathes, presses, printing plants, etc.

Ind., Indianapolis—The Bd. Educ.—lathes, presses, printing plants, tc.

Mich., Albion—The Albion Fdry. and Machine Co., A. C. Hudnutt, Mgr.—miscellaneous machine shop equipment.

Mich., Bad Axe.—The Bad Axe Machine Co., Box 86—lathe, milling machine, cutter, tool grinder, drill press and power hacksaw.

Mich., Detroit—The Rex Mfg. Co., 74 State St.—miscellaneous metal working equipment.

Mich., St. Joseph—The Upton Machine Wks.—miscellaneous machine tool equipment for manufacture of electric washing machines.

O., Cincinnati—The MacLeod Co., Bogen St.—one power punch with large gap, to punch ¾ in. hole in ¼ in. plate.

O., Cleveland—The Amer. Steel and Wire Co., Western Reserve Bldg.—one large grinder.

O., East Palestine—The Efficiency Electric Co.—one riveting machine.

O., Medina—The Medina Machine Co.—machine tools for manufacture of automobile spot lights.

Wis., Milwaukee—The Acme Motor Parts Corp., 355 East Water St., W. S. Smulski, Purch. Agt.—two automatic screw machines and punch presses.

Wis., Milwaukee—L. Burnmeister Co., 28th and Burnham Sts.—one squaring shear.

Wis., Milwaukee—The Federal Pressed Steel Co., Kefe and North Pierce Sts.—machine tool equipment.

Wis., Milwaukee—The Heil Co., 26th and Montana Aves., J. Heil, Purch. Agt.—heavy punch presses.

Wis., Milwaukee—The Mechanical Products Co., 120 Wisconsin St., J. W. Flynn, Purch. Agt.—machine shop equipment.

Wis., Milwaukee—The M. J. Walsh Co., 141 Sycamore St.—punch presses and milling machines.

Wis., Milwaukee—The Water Dept., City Hall, F. J. Murphy, Purch. Agt.—one 24 in. lathe with 16 ft. bed and one 16 in. lathe with 10 ft. bed.

Wis., Milwaukee—The West Side Buick Co., 2713 Grand Ave., A. Sherman, Purch. Agt.—one 18 in. lathe and one drill press.

Wis., Oshkosh—The Oshkosh Four Wheel Drive Truck Co.—miscellaneous machine tools.

Machinery

The following concerns are in the market for machinery:

D. C., Washington—The Bureau of Yards and Docks, Navy Dept.—10 ton electric traveling cranes for navy yards at Norfolk, Va., New York, N. Y., and Philadelphia, Pa.

N. J., Elizabeth—The Wildman Mfg. Co.—foundry equipment.

Ala., Mt. Vernon—The Mobile Wood Products Co., B. Bowman, Mgr.—wood working lathes.

Va., Richmond—The A. J. Craft Piano Co., 20th and Franklin Sts.—woodworking and high grade cabinet working machinery.

Va., Richmond—The Old Dominion Beverage Co., West Broad St., C. Saunders, Purch. Agt.—bottling machinery and syrup mixers.

Ill., Chicago—The Union Steel Sales Co., 5605 Wayne Ave.—4 slide worming machines for manufacture of small wire articles.

Ind., Indianapolis—The Pioneer Brass Wks., 424 Pennsylvania St.—moulding machines.

Ind., Kokomo—The Kokomo Malleable Iron Co.—miscellaneous foundry equipment.

Mich., Detroit—Crane & Co., Atwater and Randolph Sts.—one mono rail crane.

Mich., Detroit—The Insulating Materials Co., 805 Wesson Ave.—one sheet iron folder, 36 in. or wider.

O., Lima—The Vapo Stove Co.—various equipment for manufacture of hydro carbon oil burners.

O., Newark—The Halliday Motor Car Co., A. Huth, Purch. Agt.—miscellaneous equipment.

Wis., Beloit—The Beloit Iron Wks.—two 3 ton cranes.

Wis., Beloit—The Fairbanks Morse Mfg. Co., W. W. Tracey, Eng.—moulding machinery.

Wis., Kenosha—The Kenosha Fdry. Co., 387 Exch. St., F. J. Farnum, Purch. Agt.—one electric traveling crane.

Wis., Madison—The Peninsular Power Co., 530 State St.—electric cranes.

Wis., Milwaukee—A. G. Hensel, 796 Layton Blvd.—one 24 in. planer and one 24 in. disk sander with tilting table.

Wis., Milwaukee—The Milwaukee Woven Wire Wks., 3014 Clarke St.—special wire weaving machinery.

Wis., New London—The Hatten Lumber Co.—lath mill machinery.

Wis., Oconomowoc—E. O. Otto—woodworking machinery.

Wis., Wauwatosa—The E. G. Hodge Co., 33 Kenwood Blvd., F. J. Chlupp, Purch. Agt.—dies and jigs.

Neb., Omaha—The Item Biscuit Co., 1202-24 Capitol St.—$500,000 worth of equipment for Memphis, Tenn., plant.

Ont., London—The Columbia Handle Co.—W. H. Braddon, Mgr.—woodworking machinery.

Spain, Barcelona—The Manufactras Rovirata, J. M. Rovirata, Pres.—machinery for manufacture of nails and wood screws.

Metal Working

NEW ENGLAND STATES

Conn., Cedar Hill (New Haven P. O.)—The New York, New Haven & Hartford Ry., New Haven, will build a 1 story, 100 x 160 ft. addition to its shop here. Estimated cost, $60,000.

Conn., East Hartford (Hartford P. O.)—The A. F. Way Co., 32 Union Pl., Hartford, has awarded the contract for the construction of a 1 story, 50 x 100 ft. factory here for the manufacture of machine tools. Estimated cost, $75,000. Noted July 8.

Conn., Hartford—D. D'Amico, 503 Albany Ave., plans to build a 2 story, 80 x 80 ft. garage on Morgan St. Estimated cost, $50,000. D. A. Guerriero, 647 Main St., Archt.

Conn., Hartford—The J. M. Ney Co., Elm and West Sts., has awarded the contract for the construction of a 1 story, 50 x 75 ft. addition to its factory for the manufacture of dental supplies. Estimated cost, $20,000. Noted July 1.

Conn., Plantsville—The Atwater Mfg. Co. is preparing plans for the construction of a factory for the manufacture of special castings, to replace the one which was recently destroyed by fire. Estimated cost, $100,000.

Conn., Stamford—The Perfection Enameling and Painting Co., Main and Grove Sts., is peparing plans for the construction of a 3 story, 100 x 125 ft. machine and blacksmith shop at its plant.

Me., Augusta—The State Highway Comm. has awarded the contract for the construction of a 2 and 3 story, 80 x 410 ft. garage and machine shop on Grove St. Estimated cost, $250,000.

Me., Lewiston—The Lewiston Brick Co. has awarded the contract for the construction of a 3 story sales and service station on Main St. Estimated cost, $150,000.

Mass., Brookline—B. Davis, Albany and Oswego Sts., Boston, will build a 1 story, 70 x 220 ft. garage on Brainerd Rd. Estimated cost, $80,000. Noted June 17.

Mass., Cambridge—The Natl. Co., 167 Oliver St., Boston, has awarded the contract for the construction of a 2 story, 50 x 80 ft. factory on Brookline St. here for the manufacture of mechanical specialties. Estimated cost, $25,000.

Mass., Cambridge—The Suffolk Engraving and Electotyping Co., 394 Atlantic Ave., Boston, will soon award the contract for the construction of a 6 story, 100 x 100 ft. factory on Main St. here. Estimated cost, $225,000.

Mass., Jamaica Plain (Boston P. O.)—The Holtzer Cabot Electric Co., 125 Amory St., has awarded the contract for the construction of a 1 story, 50 x 80 ft. factory addition for the manufacture of motors and dynamos. Estimated cost, $15,000. Noted July 8.

Mass., Lynn—The General Electric Co., 84 State St., has awarded the contract for the construction of a 1 story addition to its plant for the manufacture of electric specialties. Estimated cost, $100,000. Noted June 24.

Mass., New Bedford — The Motor Sales Co., 514 Pleasant St., will soon award the contract for the construction of a 2 story service station on Purchase St. Estimated cost, $100,000. LaBoode & Bullard, 255 Union St., Archts.

Mass., New Bedford—J. C. Rhodes & Co., Inc., 123 Front St., will soon award the contract for the construction of a 4 story addition to its factory on Front and 4th Sts., for the manufacture of eyelets. Estimated cost, $150,000.

Mass., Norfolk Downs (Boston P. O.)—The Boston Gear Wks. has awarded the contract for the construction of a 1 and 2 story, 100 x 120 ft. factory for the manufacture of gears, etc. Estimated cost, $60,000.

Mass., Salem—J. J. McAuliffe & W. J. Fox, 150 Washington St., plan to build a 1 story garage on Washington and Norman Sts. Estimated cost, $50,000.

Mass., Somerville — The Great Atlantic and Pacific Tea Co., 451 D St., South Boston, has awarded the contract for the construction of a machine shop and garage on Pittsburgh St. here. Estimated cost, $75,000.

Mass., Springfield — The Buckley Fdry. Co., 13½ Cypress St., has awarded the contract for the construction of a 1 story, 85 x 100 ft. foundry on Roseland St. Estimated cost, $8,600.

Mass., Springfield—The Davitt Iron Fdry. Co., 191 Liberty St., will build a 1 and 2 story, 55 x 105 ft. foundry. Estimated cost, $15,000.

Mass., Watertown — The Aetna Mills, Pleasant St., has awarded the contract for the construction of a 1 story, 45 x 110 ft. garage at its plant. Estimated cost, $35,000. Noted July 8.

Mass., Watertown—The Walker & Pratt Mfg. Co., 31 Union St., is having plans prepared by Lockwood, Greene & Co., Engrs. and Archts., 60 Federal St., Boston, for the construction of a 1 story, 200 x 230 ft. foundry at its plant for the manufacture of stoves.

Mass., Worcester—The Livingstone Motor Co., 119 Grafton St., has awarded the contract for the construction of a 1 story addition to its garage on Shrewsbury St. Estimated cost, $15,000.

MIDDLE ATLANTIC STATES

N. J., Orange—The Monroe Calculating Machine Co., Mitchell St., is having plans prepared by the Amer. Concrete Steel Co., Archts. and Engrs., 27 Clinton St., Newark, for the construction of a 4 story, 68 x 178 ft. addition to its plant.

N. Y., Buffalo—The Parenti Motors Corp., 1754 Main St., plans to build a 1 story, 105 x 350 ft. factory on Kensington Ave. along the tracks of the Delaware, Lackawanna & Western Ry. Estimated cost, $200,000.

N. Y. Buffalo—The Standard Oil Co. of New York, 26 Bway., New York City, has awarded the contract for the construction of a 4 story, 105 x 115 ft. addition to its garage here.

N. Y., New York (Borough of Brooklyn)—The Natl. Lead Co., 111 Bway., New York City, has awarded the contract for the construction of a 4 story, 50 x 100 ft. factory on Marshall St. Estimated cost, $110,000.

N. Y., New York (Borough of Manhattan)—M. R. Ames, 7 East 42nd St., will build a 1 story, 75 x 100 ft. garage on Jerome Ave. and 176th St. Estimated cost, $35,000.

N. Y., New York (Borough of Manhattan)—J. M. Felson, 1133 Bway., will build a 2 story, 75 x 100 ft. garage on 36th St. Estimated cost, $60,000.

N. Y., New York (Borough of Manhattan)—T. Jeffrey, 160 Sherman Ave., will build a 1 story, 50 x 150 ft. garage. Estimated cost, $30,000.

N. Y., New York (Borough of Manhattan)—H. Kauffman & Son, 206 Division St., will build a 3 story, 25 x 150 ft. garage on South St. Estimated cost, $75,000.

N. Y., Syracuse—The Standard Oil Co. of New York, 26 Bway., New York City, has awarded the contract for the construction of a plant here, to consist of a 1 story, 60 x 120 ft. garage, 1 story, 36 x 90 ft. boiler and pump house, 1 story, 40 x 55 ft. tank house and 2 story, 100 x 140 ft. warehouse.

Pa., Carbondale—The Hendrick Mfg. Co. is building a 2 story, 75 x 150 ft. machine shop for the manufacture of tools used in production of perforated metals.

Pa., Philadelphia—A. Prestcoe, c/o J. E. Fieldstein, Archt., Penfield Bldg., will soon award the contract for the construction of a 2 story, 50 x 120 ft. garage at 707 Tasher St. Estimated cost, $10,000.

Pa., Philadelphia—G. Shields, 231 North Juniper St., will soon award the contract for the construction of a 2 story, 95 x 120 ft. garage at 212 North Juniper St. Estimated cost, $10,000. C. E. Oelschlager, 1615 Walnut St., Archt.

Pa., Cedar Grove—J. F. Stokes, 17th and Cambria Sts., has awarded the contract for the construction of a 1 story, 90 x 160 ft. and 140 x 300 ft. plant for the manufacture of chemical machinery.

Pa., Norristown—The Wildman Mfg. Co. will soon award the contract for the construction of a foundry, etc. Estimated cost, $75,000. Lockwood Greene & Co., 101 Park Row, New York City, Archts.

SOUTHERN STATES

Ky., Louisville—The Louisville Motor Co. is building a machine shop addition at its garage.

Tenn., Hollow Rock Junction (Hollow Rock P. O.)—The Nashville, Chattanooga and St. Louis Ry., Nashville, plans to build shops and terminals here. Estimated cost, $600,000. H. McDonald, Nashville, Ch. Engr.

Va., Toms Creek—The Virginia Iron, Coal and Coke Co., Roanoke, will build a 50 x 100 ft. machine and carpenter shop here. W. M. Huffman, Supt.

Va., Richmond — J. T. Disney & D. J. Cole, Murphy Hotel, 8th and Broad Sts., have awarded the contact for the construction of a 46 x 60 x 190 ft. garage and repair shop on Pine and Broad Sts. Estimated cost, $65,000.

MIDDLE WEST

Ill., Chicago—The Great Western Smelting and Refining Co., 620 West 41st St., plans to build a smelting plant on Union Ave. and 51st St. Estimated cost, $1,000,000. H. E. Newhouse, 4630 Prairie Ave., Archt.

Ill., Quincy—The Wall Pump and Compressor Co., Box 381, has leased a 2 story, 60 x 150 ft. building and will install machinery for the manufacture of vacuum pumps. G. W. Gille, c/o owner, Engr.

Ill., Rockford — The Rockford Malleable Iron Wks. is building a factory for the manufacture of malleable castings. F. C. Rutz, Mgr.

Ind., Indianapolis — The Bd. Educ. will soon award the contract for the construction of a 2 story school on Martindale Ave., to include a manual training department. Estimated cost, $425,000.

Ind., Indianapolis — The Pioneer Brass Wks., 424 Pennsylvania St., has awarded the contract for the construction of a 1 story, 200 x 300 ft. factory on 23rd St. along the tracks of the Lake Erie Western R.R. Estimated cost, $200,000.

Ind., Kokomo — The Kokomo Malleable Iron Co. plans to build a plant for the manufacture of malleable castings. W. G. McCoy, Kokomo, Engr.

Ind., South Bend — The Campbell Wire Specialty Wks. is building a 1 story, 66 x 165 ft. factory. Estimated cost, $50,000. M. Campbell, Pres.

Mich., Detroit—The Detroit Transportation Assn., c/o F. L. Henk, Secy. Bd. Commerce, is preparing plans for the construction of a 1 story, 150 x 165 ft. garage and freight terminal on 14th Ave. and Howard St. Estimated cost, $75,000.

Mich., Pontiac—The Oakland Motor Car Co. is building an addition to its plant for the manufacture of automobile parts. Estimated cost, $3,000,000.

Mich., Saginaw—The Water Dept., City Hall, will soon award the contract for the construction of a 1 and 2 story, 52 x 80 ft. warehouse and repair shop. Estimated cost, $30,000. Cowles & Mutscheller, Case Blk., Archts.

O., Canton—The Canton Drop Forge Co., 3400 Odd Row Pl., will build a 1 story, 95 x 100 ft. factory on Willet Ave. S. E. Estimated cost, $45,000.

O., Cincinnati—The Edwards Mfg. Co., 3rd and Eggleston Aves., manufacturer of metal specialties, is having plans prepared for the construction of a 4 or 6 story, 95 x 308 ft. plant.

O., Cleveland—C. A. Foster, of the Packard Motor Car Co., 5206 Prospect Ave., has purchased a site at 6612 Euclid Ave. and plans to construct a 2 story, 75 x 180 ft. garage and sales building. Estimated cost, $200,000.

O., Cleveland — The Republic Tool and Mfg. Co., 1399 West 9th St., plans to build a 1 story, 60 x 210 ft. factory on Harvard Ave. and Independence Rd. Estimated cost, $100,000. C. E. Lowe, Pres.

O., Lima—The Vapor Stove Co. plans to build a 100 x 200 ft. factory for the manufacture of hydro carbon oil burners. W. De Kalb, Holland Blk., Engr.

Wis., Milwaukee—R. P. Hansen, 529 26th Ave., has awarded the contract for the construction of a 1 story, 100 x 160 ft. garage on Ogden Ave. Estimated cost, $45,000. Noted May 27.

Wis., Milwaukee—The Milwaukee Woven Wire Wks., 3014 Clarke St., is building a 1 story, 60 x 120 ft. addition to its factory. Estimated cost, $30,000.

Wis., Milwaukee—M. Stuck, 903 Vliet St., plans to build a 1 story, 50 x 70 ft. garage on Central Ave. Estimated cost, $25,000. G. Klengendorff, 121 Wisconsin St., Archt.

WEST OF THE MISSISSIPPI

Minn., Minneapolis — The Bd. Educ. is having plans prepared by E. H. Enger, Archt., c/o Bd. Educ., for the construction of a 3 story junior high school on Emerson Ave. and 30th Ave., N., to include a manual training department. Estimated cost, $600,000.

Mo., St. Louis — The Columbia Taxicab Co., 4539 Delmar Blvd., has awarded the contract for the construction of a 1 story, 150 x 150 ft. garage. Estimated cost, $100,000.

N. D., Lankin—The Galt School Dist 39 will soon award the contract for the construction of a 2 story, 62 x 95 ft. school, to include a manual training department. Estimated cost, $100,000. K. P. Nappen, Clk. B. D. Keck, 1st Natl. Bank Bldg., Grand Forks, Archt.

WESTERN STATES

Cal., San Francisco — The Pacific Nash Motor Co., 1529 Van Ness Ave., is building a 4 story, 72 x 190 ft. sales and service building.

CANADA

Ont., London—The Grand Trunk Ry. is having plans prepared for the construction of three buildings to be equipped with various wood and iron working machinery for salvaging cars. Estimated cost, $300,000. F. L. C. Bond, 2960 Hubert St., Montreal, Que., Ch. Engr.

General Manufacturing

NEW ENGLAND STATES

Conn., Groton—M. Pollock, 12-16 East 22nd St., New York City, has awarded the contract for the construction of a 2 story, 60 x 180 ft. dyehouse, here.

Conn., New Haven—The Natl. Folding Box and Paper Co., James St., plans to build an addition to its plant.

Conn., New Haven—The New Haven Pulp and Board Co. has awarded the contract for the construction of a factory. Estimated cost, $30,000.

Mass., Boston—The W. F. Schraft & Sons Corp., 150 Washington St., will soon award the contract for the construction of a 3 story, 80 x 240 ft. factory on Causeway St., for the manufacture of candy. Estimated cost, $200,000. Haven & Crosby, 40 Court St., Archts. and Engrs. Noted July 15.

Mass., Cambridge—The Atwood & McManus Box Co., Vale St., Chelsea, will soon award the contract for the construction of a 1 story, 90 x 105 ft. dry kiln building on Aberdeen Ave. Estimated cost, $35,000. Haven & Crosby, 40 Court St., Boston, Archts. and Engrs.

Mass., Cambridge—The Johnson Educator Food Co., 100 Sidney St., has awarded the contract for the construction of a 3 story, 106 x 127 ft. addition to its bakery. Estimated cost, $125,000. Noted June 3.

Mass., East Everett—The Boston Varnish Co. will soon award the contract for the construction of an addition to its plant. Estimated cost, $30,000. C. L. Betton, 31 Beach St., Lynn., Archt.

Mass., Holyoke—The New England Tire and Rubber Co. has awarded the contract for the construction of a 3 story, 110 x 210 ft. factory on Main St. Complete equipment for manufacture of rubber and tires will be installed. Estimated cost, $350,000. Noted July 15.

Mass., Somerville—The Sturtevant & Haley Beef and Supply Co., 40 Fanuel Hall, Boston, has awarded the contract for the construction of a 2 story, 25 x 60 ft. cold storage plant on Somerville Ave., here. Estimated cost, $20,000.

N. H., Rochester—W. H. Champlain will build a 1 story, 82 x 85 ft. addition to his factory for the manufacture of boxes. Estimated cost, $20,000.

R. I., Woonsocket—The Lafayette Worsted Co., Hamlet Ave., is having plans prepared by W. F. Fontaine, Federal Bldg., Archt., for the construction of a 2 story, 135 x 250 ft. addition to its factory for the manufacture of textiles.

MIDDLE ATLANTIC STATES

D. C., Washington—The Star Newspaper Co., 11th and Pennsylvania Aves., will soon award the contract for the construction of a 9 story addition to its plant. Marsh & Peter, 532 13th St., Engrs. and Archts.

N. J., Jersey City—The Amer. Butterine Co., 107 Hudson St., is having plans prepared for the construction of a 4 story factory, office building, etc., on 8th and Henderson Sts. Estimated cost, $100,000.

N. Y., New York (Borough of Manhattan)—The Rigaud Perfume Co., 75 Barrow St., will soon award the contract for the construction of a 7 story, 50 x 50 ft. factory. Sommerfield & Steckler, 31 Union Sq., Archts. and Engrs. Noted July 15.

N. Y., New York (Borough of Queens)—Stein Hall & Co., Inc., 61 Bway., New York City, has awarded the contract for the construction of a 4 story factory on 6th and Jackson Aves. for manufacture of tapioca and starches. Estimated cost, $400,000.

N. Y., Richmond Hill (Jamaica P. O.)—R. M. Krauser, c/o C. Bauer, Archt. and Engr., manufacturers of gold seals, 788 Manhattan Ave., Brooklyn, will build a 3 story, 60 x 100 ft. factory, here. Estimated cost, $80,000. Noted June 24.

Pa., Jeanette—The Amer. Window Glass Co., Farmers' Bank Bldg., Pittsburgh, has awarded the contract for the construction of a 1 story, 42 x 180 ft. cutting room building. Noted May 6. A contract has also been awarded for the construction of a 1 and 2 story furnace building. Estimated cost, $300,000.

SOUTHERN STATES

Ala., Mt. Vernon—The Mobile Wood Products Corp. is building a factory for the manufacture of veneer. B. A. Bowman, Mgr.

Ky., Louisville—The Dixie Belle Refining Co., 701 Inter-Saw Bldg., will soon award the contract for the construction of a refinery on Western Parkway. Estimated cost, $500,000.

N. C., Four Oaks—The Ivanhoe Mfg. Co., Smithfield, plans to build a 1 story, 10,000 spindle mill here. J. E. Sirrine, Greenville, S. C., Engr.

S. C., Gaffney—The Cherokee Weaving Mills plan to build a 2 story, 50 x 100 ft. weave shed addition to its plant for the manufacture of mercerized shirting. Estimated cost, $30,000.

S. C., Greenville—The Dunean Mills will build a 80 x 150 ft. factory for the manufacture of silk.

Tenn., Memphis—The Fly Shot Co., Nashville, Ga., has purchased a site on Iowa Ave. and 4th St., here, and plans to build a 2 story, 50 x 150 ft. factory for the manufacture of insecticides. Estimated cost, $1,000,000.

Tenn., Memphis—The Item Biscuit Co., 1202-24 Capitol Ave., Omaha, Neb., has awarded the contract for the construction of an 8 story, 290 x 450 ft. factory on Florida St., here. Estimated cost, $500,000. Noted Jan. 15.

Va., Roanoke—The Greenston Products Co., Inc., is building a slate granule plant to have a daily capacity of 1,000 tons. Estimated cost, $150,000.

MIDDLE WEST

Ind., Indianapolis—The U. S. Corrugated Fiber Box Co. is having plans prepared by C. E. Bacon, Archt., 617 Mechanics' Bank Bldg., for the construction of a 4 story, 100 x 160 ft. factory on Martindale Ave. Estimated cost, $125,000.

Ind., Portland—The Portland Oil and Refining Co. will build a 500 bbl. refinery for gasoline, kerosene and gas oil. Estimated cost, $100,000.

Mich., Detroit—The Detroit Casket Co., 185 Congress St., is having plans prepared by Van Leyen, Schilling, Keough & Reynolds, Archts., Cass Ave., for the constructions of a 3 story, 115 x 150 ft. factory. Estimated cost, $100,000.

O., Cincinnati—The Lunken Window Co., 4018 Cherry St., plans to build a 25 x 100 ft. factory.

O., Troy—The Gummed Products Co. is preparing plans for the construction of a 2 story, 100 x 140 ft. factory on Market St. for the manufacture of labels, etc. Estimated cost, $200,000.

WEST OF THE MISSISSIPPI

Ia., Des Moines—The Sargent & Ash Milling Co. is preparing plans for the construction of a 4 story flour mill and plant on Guthrie Ave. Estimated cost, $200,000.

Mo., St. Louis—The Ralston Purina Co., 821 South 8th St., has awarded the contract for the construction of a 5 story flour and feed mill on 8th and Gratiot Sts. Estimated cost, $50,000.

Mo., St. Louis—The St. Louis Surfacer & Paint Co., 5432 Hazel Ave., has awarded the contract for the construction of a 2 story, 40 x 64 ft. factory. Estimated cost, $30,000.

Tex., San Antonio—The Lone Star Brewery Co., 124 Jones Ave., plans to convert its plant into a textile mill, to have a capacity of 15,000 spindles. The company will be known as the Lone Star Cotton Mills, and will have a capital stock of $1,300,000. Gregg & Co., 24 Clinton St., Newark, N. J., Engrs.

CANADA

Ont., Ft. William—The Ft. William Pulp and Paper Co., Ltd., c/o J. S. Sutherland, Archt., Dayton, O., will receive bids until Aug. 1 for the construction of a mill on the mouth of Mission River. Estimated cost, $1,000,000.

Ont., Oakville—The Oakville Basket and Veneer Wks. will build a 3 story, 80 x 170 ft. factory on Lake Shore Rd. Estimated cost, $150,000. J. Berrell, Supt.

Ont., Owen Sound—The A. Grey Upholstering Co. will soon award the contract for the construction of a 2 story, 50 x 85 ft. factory on 3rd Ave. Estimated cost, $35,000.

Ont., Port Arthur—The Nipigon Fiber and Paper Mills, Ltd., will receive bids until Aug. 15 for the construction of a 40 ton pulp mill in Nipigon Dist. Estimated cost, $200,000. J. A. Little, Port Arthur, Archt.

Que., Montreal—The Standard Iron and Chemical Co., 524 Ambrose St., will soon award the contract for the construction of a 4 story addition to its plant. Cost to exceed $100,000.

Que., Nouvelle—A. Filion, Ltd., will soon award the contract for the construction of a planing and saw mill. Estimated cost, including equipment, $100,000.

Que., Thetford Mines—A. Lemieux will soon call for bids for the construction of a saw mill.

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